PHYSICS

BOOKS - PRADEEP PHYSICS (HINGLISH)

MAGNETIC EFFECT OF CURRENT AND MAGNETISM

Solved Examples

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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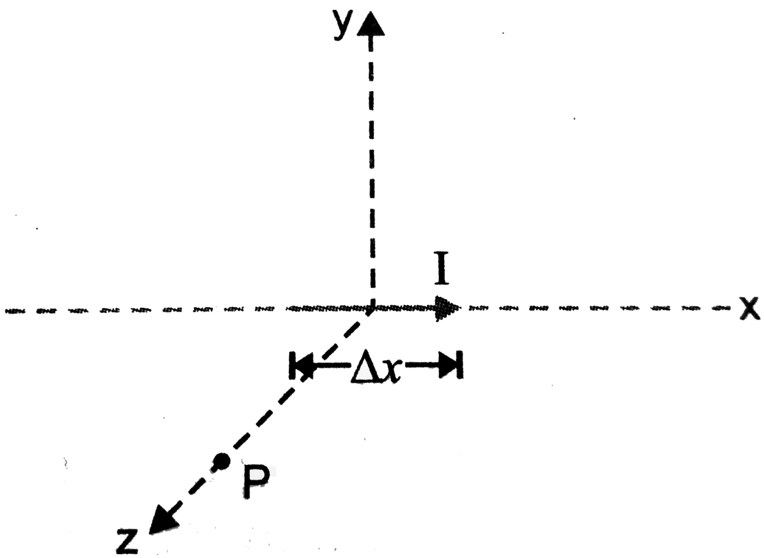
2. An element, $\Delta\vec{t} = \Delta x\hat{i}$ is placed at the origin as shown in figure and carries a current 5A. Find out the magnetic field at point P on the z-axis at a distance of $2 - 0m$ due to the element $\Delta x = 1cm$. Give also, the direction of the magnetic field produced.



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3. An infinitely long straight conductor carries a current of $100A$. At what distance from the conductor is the magnetic field caused by the current equal to $0.5 \times 10^{-4} T$?

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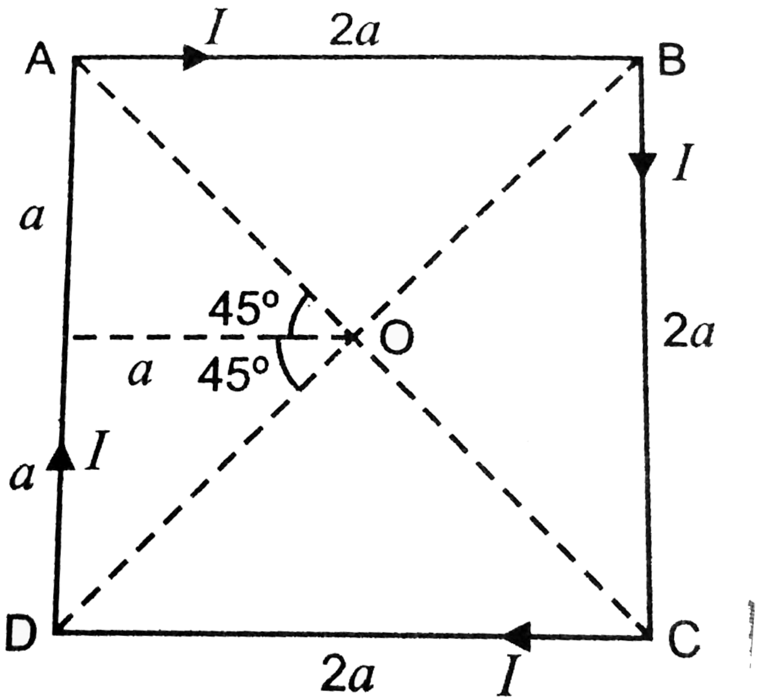
4. Find an expression for the magnetic field induction at the centre of a coil bent in the form of a square of side $2a$, carrying current I, figure



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5. In hydrozen atom, the electron is making 6.6×10^{15} revolution per second in a circular path of radius $0.53A^{\circ}$. What is the magnetic induction produced at the centre of the orbit?

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6. A circular current carrying coil has a radius R. The distance from the centre of the coil on the axis where the magnetic induction will be $(1/8)^{th}$ of its value at the centre of the coil is,

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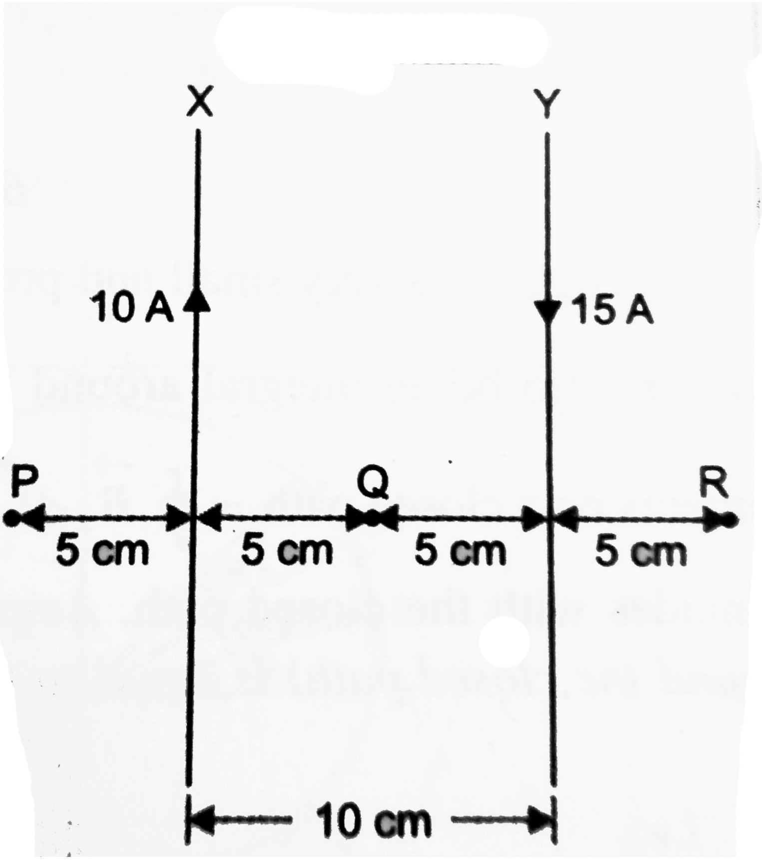
7. There are two parallel current carrying wires X and Y as shown in figure. Find the magnitude and direction of the magnetic field at points, P, Q and R.



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8. A long straight solid metal rod of radius $4cm$ carries a current $2A$, uniformly distributed over its circular cross-section. Find the magnetic field induction at a distance $3cm$ from the axis of the wire.

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9. A solenoid $50cm$ long has 4 layers of windings of 350 turns each. The radius of the lowest layer is $1 \cdot 4cm$. If the current carried is $6 \cdot 0A$, estimate the magnitude of magnetic flux density (i) near the centre of the solenoid on its axis, (ii) near the ends on its axis, (iii) outside the solenoid near its centre.

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10. A coil wrapped around a toroid has inner radius of $10 \cdot 0cm$ and outer radius of $12 \cdot 0cm$. If the wire wrapped makes 1100 turns and carries a current of $5A$, find the magnetic field (a) inside the core of the toroid (b) outside the toroid at a distance $10cm$ from the other surface of toroid.

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11. A current of $5A$ is flowing from south to north in a straight wire. Find the magnetic field due to a $1cm$ piece of wire at a point $1m$ north east from the piece of wire.

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12. An element $d\vec{l} = dx\hat{i}$ (where $dx = 1cm$) is placed at the origin and carries a large current $i = 10A$. What is the magnetic field on the Y-axis at a distance of $0.5m$?

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13. A current element $3dl$ is at $(0, 0, 0)$ along y-axis. If $dl = 1cm$, find the magnetic field at a distance $20cm$ on the x-axis.

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14. A straight wire carries a current of $6A$ from south to north direction. What is the magnetic field due to $1cm$ piece of wire at a point $50cm, 30^\circ$ east of north?

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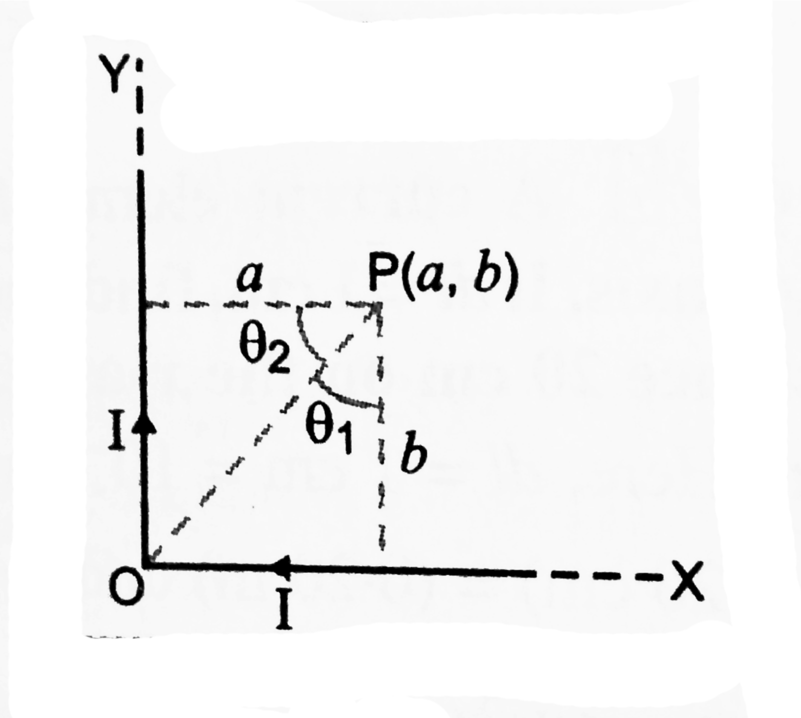
15. Two semi infinitely long straight current carrying conductors are held in the form as shown in figure. One common end of them is at the origin. If both the conductors carry same current I, find the value of the magnetic field induction at a point (a, b).



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16. Same current i is flowing in the three infinitely long wires along positive x-,y- and z-directions. The magnetic filed at a point (0,0,-a) would be

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17. A long straight wire carrying a current of $20A$ is placed in an external uniform magnetic field of $3 \times 10^{-4}T$ parallel to the current. Find the magnitude of resultant field at a point $2 \cdot 0cm$ away from the wire.

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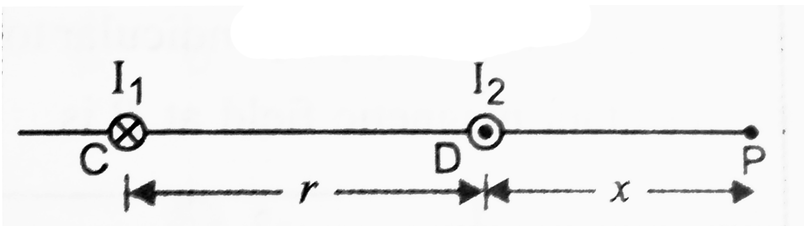
18. Two parallel wires C and D placed perpendicular to the plane of paper at a separation of $r(= 8cm)$, carry electric currents $I_1 = 6A$ and $I_2 = 3A$ in opposite directions as shown in figure. Find the point on the line CD where the resultant magnetic field is zero.



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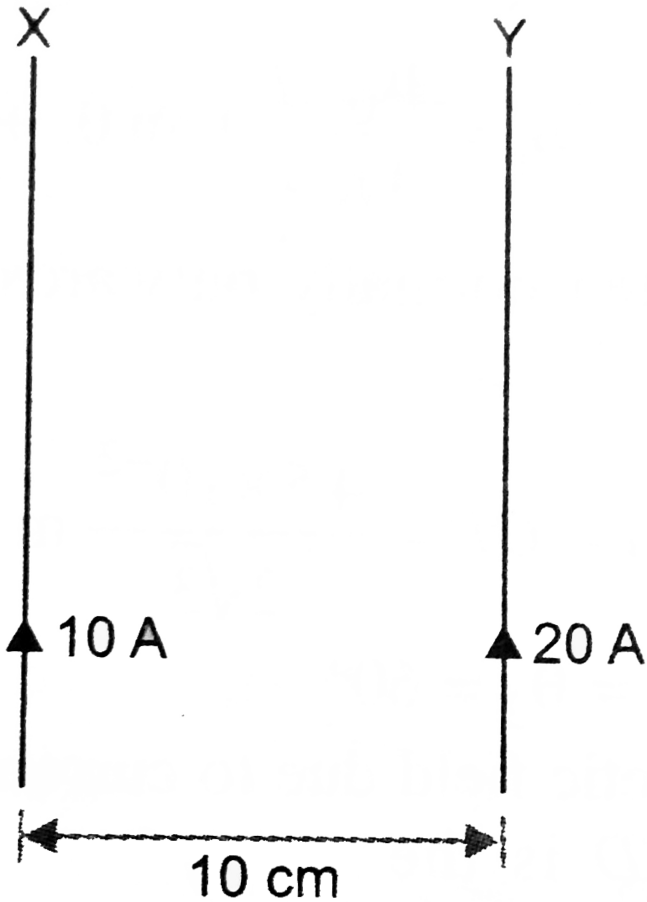
19. There are two parallel current carrying wires X and Y as shown in figure. Find the distance of a point from wire X, where the resultant magnetic field is zero.



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20. A current of $1 \cdot 0A$ flowing in the sides of an equilateral triangle of side $4 \cdot 5 \times 10^{-2}m$. Find the magnetic fied at the centroid of the triangle.

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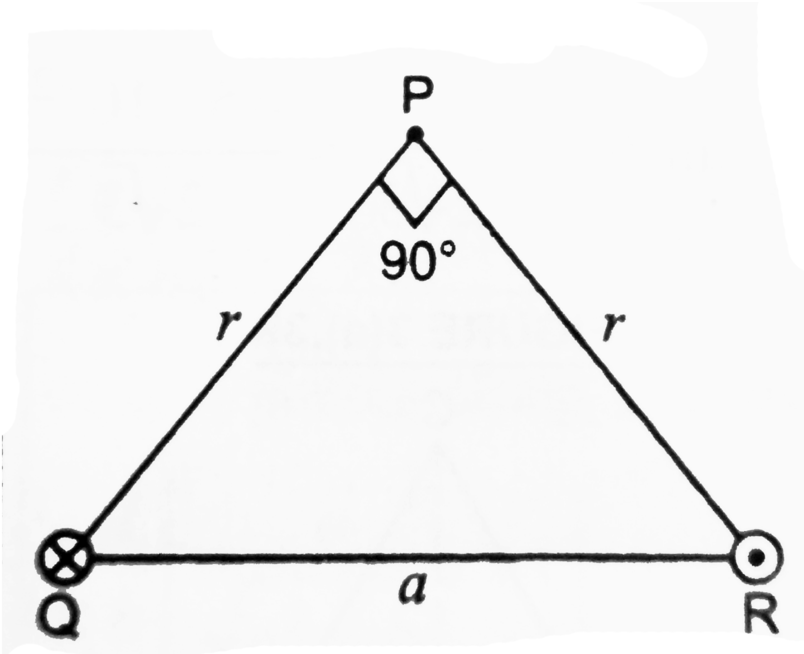
21. Figure shows a right-angled isosceles ΔPQR having its base equal to a. A current of I ampere is passing downwards along a thin straight wire cutting the plane of paper normally as shown at Q. Likewise a similar wire carries an equal current passing normally upwards at R. Find the magnitude and direction of the magnetic field induction B at P. Assume the wires to be infinity long.



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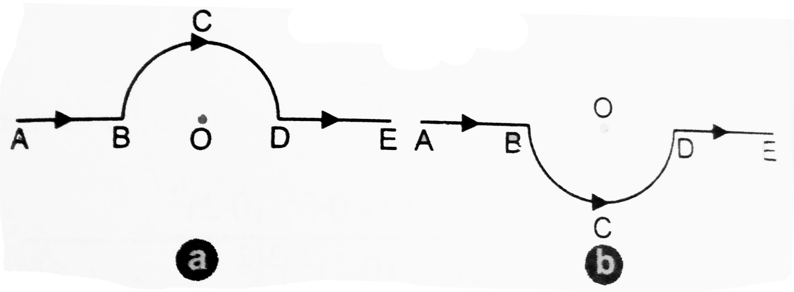
22. A straight wire carrying a current of $12A$ is bent into a semicircular arc of radius $2 \cdot 0cm$ as shown in figure. Consider the magnetic field $\vec{B}$ at the centre of arc.

(a) What is the magnetic field due to the staight segments?

(b) In what way the contribution to $\vec{B}$ from the semicircle differs from that of a circular loop and in what way does it resemble?

(c) Would your answer be different if the wire were bent into a semicircle arc of the same radius but in the opposite way as shown in figure



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23. A tightly wound 100 turn coil of radius $10cm$ is carrying a current of $1A$. What is the magnitude of the magnetic field at the centre of the coil?

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24. An alpha particle is completing one circular round of radius $0 \cdot 8m$ in 2 seconds. Find the magnetic field at the centre of the circle. Electronic charge $= 1 \cdot 6 \times 10^{19}C$.

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25. The electron in a hydrogen atom circles around the proton with a speed of $2 \cdot 18 \times 10^{6}ms^{-1}$ in an orbit of radius $5 \cdot 3 \times 10^{-11}m$. Calcualte (a) the equivalent current (b) magnetic field produced at the proton. Given charge on electron $1 \cdot 6 \times 10^{-19}C$ and $\mu_0 = 4\pi \times 10^{-7}TmA^{-1}$.

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26. A circular loop of 2 turns carries a current of $5 \cdot 0A$. If the magnetic field at the centre of loop is $0 \cdot 40mT$, find the radius of the loop.

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27. A circular coil of 120 turns has a radius of $18cm$ and carries a current of $3 \cdot 0A$. What is the magnitude of the magnetic field (i) at the centre of the coil (ii) at a point on the axis of the coil at a distance from the centre equal to the radius of the coil?

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28. Two identical circular oils of radius $0 \cdot 2m$ each having 30 turns are mounted coaxially $0 \cdot 2m$ apart. What is the magnetic field at the centre of each coil when a current of $0 \cdot 6A$ is passed through both the coils (a) in the same direction (b) in the opposite directions?

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29. Two wires A and B have the same length equal to $44cm$. and carry a current of $10A$ each. Wire A is bent into a circle and wire B is bent into a square. (a) Obtain the magnitudes of the fields at the centres of the two wires. (b) Which wire produces a greater magnetic field at the centre?

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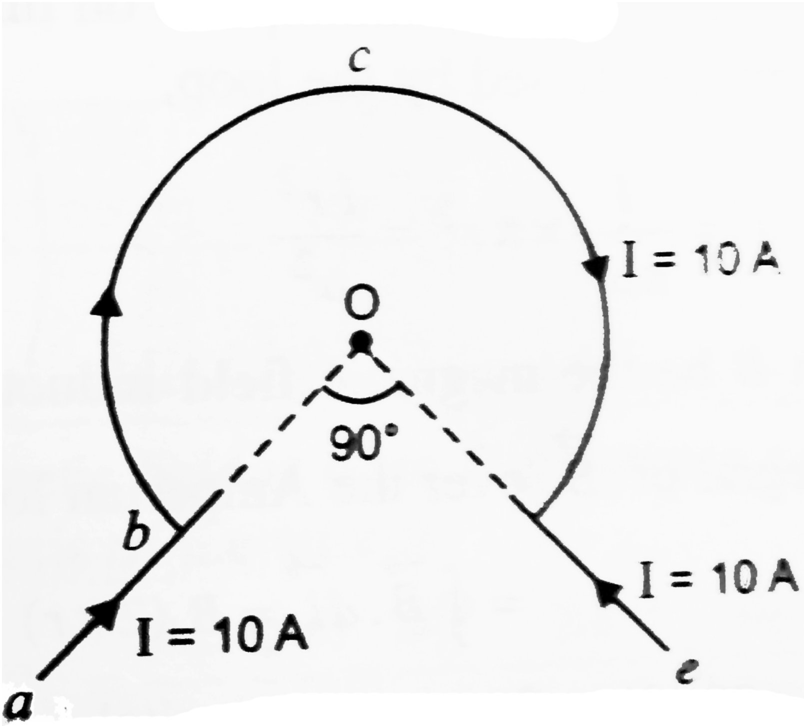
30. The wire shown in figure carries a current of $10A$. Determine the magnitude of the magnetic field at the centre O.

Given radius of the bent coil is $3cm$.



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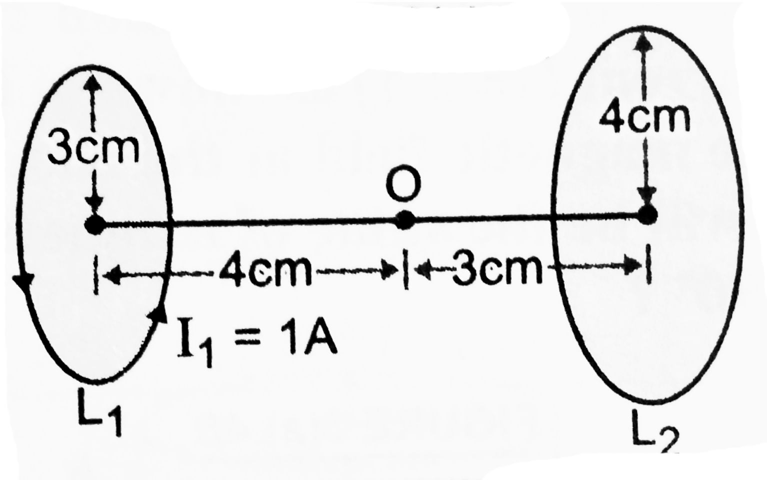
31. Two coaxial circular loops L_1 and L_2 of radii $3cm$ and $4cm$ are placed as shown in figure. What should be the magnitude and direction of the current in the loop L_2 so that the net magnetic field at the point O be zero?



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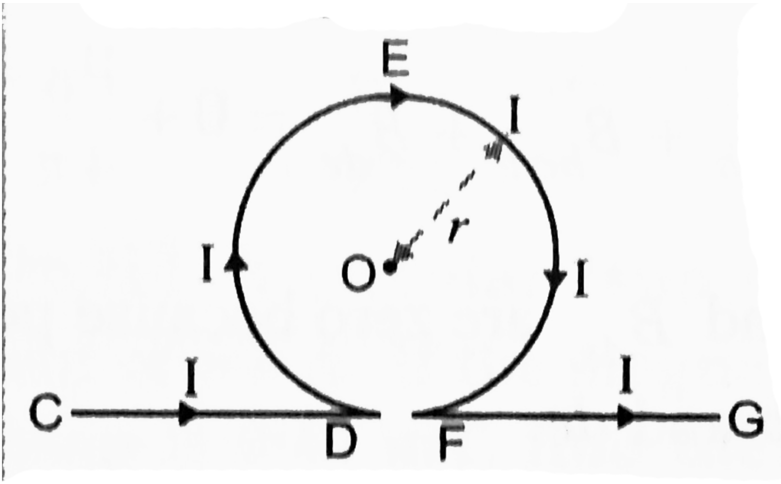
32. If a long horizontal conductor is bent as shown in figure and a current I is passed in it, find the magnitude and direction of magnetic field induction at the centre of circular part.



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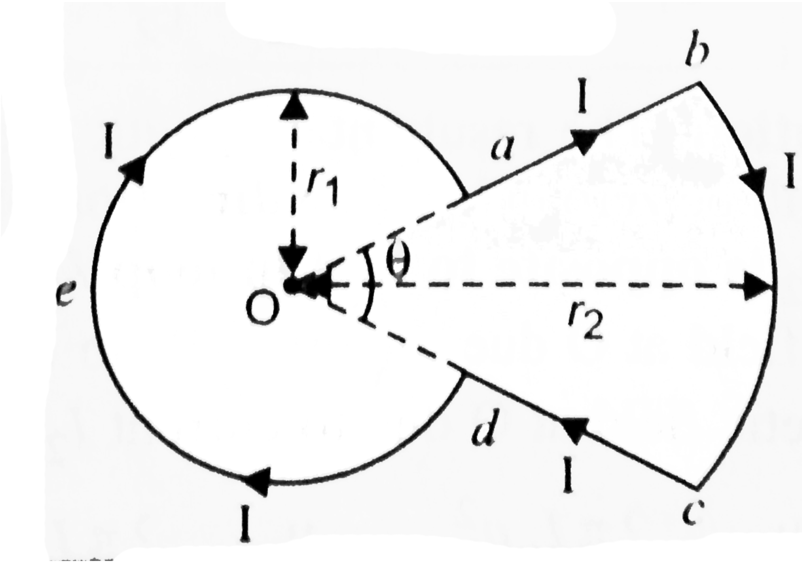
33. The current loop abcde formed by two circular segments of radii $r_1(=4cm)$ and $r_2(=6cm)$ with common centre at O, carries a current $I(=2A)$ as shown in figure. What is the magnetic field at the common centre O? What will be the value of magnetic field at

O when $\theta = 90°$?



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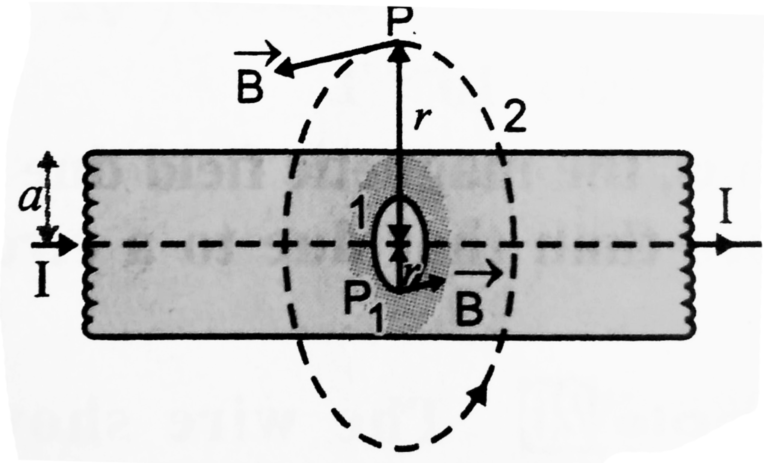
34. Figure shows a long straight wire of circular crosssection (radius a) carrying steady current I. The current I is uniformly distributed across this crosssection. Calculate the magnetic field in the region $r < a$ and $r > a$.



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35. A straight thick long wire of uniform cross-section of radius a is carrying a steady current I. Calculate the ratio of magnetic field at a point $a/2$ above the surface of the wire to that at a point $a/2$ below its surface. What is the maximum value of the field of this wire?

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36. A long straight solid conductor of radius $5cm$ carries a current of $3A$, which is uniformly distributed over its circular cross-section. Find the magnetic field induction at a distance $4cm$ from the axis of the conductor. Relative permeability of the conductor=1000.

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37. A wire of radius $0 \cdot 8cm$ carries a current of $100A$ which is uniformly distributed over its cross-section. Find the magnetic field (a) at $0 \cdot 2cm$ from the axis of the wire (b) at the surface of the wire and (c) at a point outside the wire $0 \cdot 4cm$ from the surface of the wire. Neglect the permeability of the material of wire.

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38. A solenoid of length $0 \cdot 5m$ has a radius of $1cm$ and is made up of 500 turns. It carries a current of $5A$. What is the magnitude of the magnetic field inside the solenoid?

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39. A solenoid coil of $300 turns/m$ is carrying a current of $5A$. The length of the solenoid is $0 \cdot 5m$ and has a radius of $1cm$. Find the magnitude of the magnetic field well inside the solenoid.

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40. A solenoid of length $50cm$, having 100 turns carries a current of $2 \cdot 5A$. Find the magnetic field, (a) in the interior of the solenoid, (b) at one end of the solenoid.

Given $\mu_0 = 4\pi \times 10^{-7} WbA^{-1}m^{-1}$.

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41. A copper wire having a resistance of $0 \cdot 015 \Omega$ per metre is used to wind a 500 turns solenoid of radius $1 \cdot 0 cm$ and length $22 cm$. If the e.m.f. of the battery used is $6V$, then find the magnetic field near the centre of the solenoid.

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42. A toroid has a core of inner radius $20 cm$ and outer radius $22 cm$ around which 4200 turns of a wire are wound. If the current in the wire is $10A$, what is the magnetic field

(a) inside the core of toroid (b) outside the toroid

(c) in the empty space surrounded by toroid?

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43. A coil wrapped around a toroid has inner radius of $15cm$ and outer radius of $20cm$. If the toroid has 1000 turns of wire and carries a current of $12A$, find the maximum and minimum values of magnetic field within the toroid.

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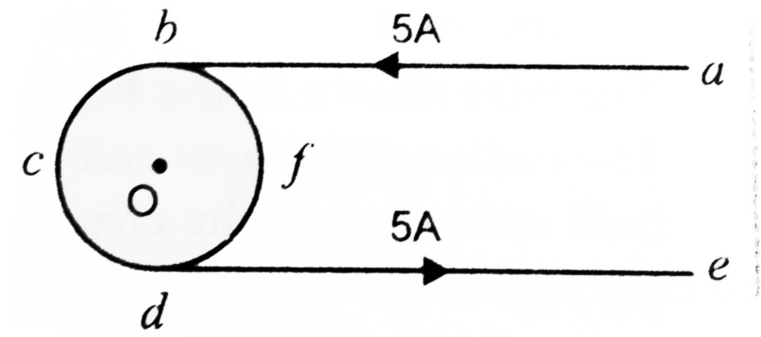
44. In figure bcdf is a circular coil of non-insulated thin uniform conductors, ab and de are very long straight parallel conductors, ab and de are very long straight parallel conductors, tangential to the coil at the points b and d. If the current $5A$ enters the coil from a to b, find the magnetic field induction at O, the centre of the coil. The diameter of the coil is $10cm$.



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45. A very long wire carrying a current $I = 5.0A$ A is bent at right angles. Find the magnetic induction at a point lying on a perpendicular to the wire, drawn through the point of hending at a distance $l = 35cm$ from it.

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46. A beam of ions with velocity $2 \times 10^5 ms^{-1}$ enters normally into a uniform magnetic field of $0 \cdot 04$ tesla. If the specific charge of ion is $5 \times 10^7 Ckg^{-1}$, find the radius of the circular path described.

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47. An electron of mass $0 \cdot 90 \times 10^{-30} kg$, under the action of magnetic field moves in a circle of radius $2 \cdot 0 cm$ at a speed of $3 \cdot 0 \times 10^6 ms^{-1}$. If a proton of mass $1 \cdot 8 \times 10^{-27} kg$ were to move in a cirlce of the same radius in the same magnetic field, find its speed.

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48. An α-particle is moving in a magnetic field of $\left(3\hat{i} + 2\hat{j}\right)$ tesla with a velocity of $\left(5 \times 10^5 \hat{i}\right) ms^{-1}$. What will be the magnetic force acting on the particle?

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49. The magnetic flux density applied in a cyclotron is $3 \cdot 5T$. What will be the frequency of electric field that must be applied between the dees in order (a) to accelerate protons (b) α-particles? mass of proton $1 \cdot 67 \times 10^{-27} kg$.

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50. 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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51. The horizontal component of earth's magnetic field at a certain place is $3 \cdot 0 \times 10^{-5} T$ and the direction of the field is form 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 diection of the current is (a) east to west (b) south to north?

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52. Two straight wires A and B of lengths $10m$ and $16m$ and carrying currents $4 \cdot 0A$ and $5 \cdot 0A$ respectively in opposite directiions, lie parallel to each other $4 \cdot 0cm$ apart, Comute the force on a $10cm$ long section of the wire B near its centre.

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53. A circular coil of $20 turns$ and radius $10 cm$ carries a current of $5A$. It is placed in a uniform magnetic field of $0 \cdot 10T$. Find the torque acting on the coil when the magnetic field is applied (a) normal to the plane of the coil (b) in the plane of coil. Also find out the total force acting on the coil.

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54. A current of $300 \mu A$ deflects the coil of a moving coil galvanometer through 60°. What should be the current to cause rotation through $\pi / 5 rad$? Determine the sensivity of this galvanometer.

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55. A galvanometer has a resistance of 50Ω. A resistance of 5Ω is connected across its terminals. What part of the total current will flow through the galvanometer?

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56. An ammeter of resistance $0 \cdot 80\Omega$ can measure current upto $1 \cdot 0A$.

(a) What must be the value of shunt resistance to enable the ammeter to measure current upto $5 \cdot 0A$?

(b) What is the combined resistance of the ammeter and the shunt?

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57. A galvanometer with a coil of resistance 12Ω shows a full scale deflection for a current of $2 \cdot 5mA$. How will you convert it into a voltmeter of range $7 \cdot 5V$? Also, find the total resistance of voltmeter formed.

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58. A cathode ray tube contains a pair of parallel metal plates $1 \cdot 0cm$ apart and $3 \cdot 0cm$ long. A narrow horizontal beam of electrons with velocity of $3 \times 10^7 ms^{-1}$ is passed down the tube mid way between the two plates. When the potential difference of $550V$ is maintained across the plates, it is found that the electron beam is so deflected that it just strikes the end of one of the plates. Find the specific charge of an electron.

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59. A proton enters a magnetic field of flux density $2 \cdot 5T$ with a speed of $1 \cdot 5 \times 10^7 ms^{-1}$ at an angle of 30° with the field, Find the force on the proton.

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60. A charged particle of charge $2 \cdot 0 \mu C$ moving along x-axis with a speed of $3 \times 10^6 ms^{-1}$ enters a magnetic field, $\vec{B} = \left(0 \cdot 3\hat{j} + 0 \cdot 4\hat{k}\right)$ tesla acting in a specific. What is the magnitude of magnetic force on the charged particle?

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61. A copper has $8 \cdot 0 \times 10^{28}$ electrons per cubic metre. A copper wire of length $1m$ and cross-sectional area $8 \cdot 0 \times 10^{-6} m^2$ carrying a current and lying at right angle to a magnetic field of strength

$5 \times 10^{-3} T$ experiences a force of $8 \cdot 0 \times 10^{-2} N$. Calculate the drift velocity of free electrons in wire.

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62. An electron travels in a circular path of radius $20 cm$ in a magnetic field $2 \times 10^{-3} T$ (i) Calculate the speed of the electron (ii) What is the potential difference through which the electron must be accelerated to acquire this speed? Charge of electron $= 1 \cdot 6 \times 10^{-19} C$. Mass of electron $= 9 \times 10^{-31} kg$.

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63. What is the radius of the path of an electron (mass $9 \times 10^{-31} kg$ and charge $1 \cdot 6 \times 10^{-19} C$) moving at a speed of $3 \times 10^{7} ms^{-1}$ in a magnetic field of $6 \times 10^{-4} T$ perpendicular to it? What is its frequency? Calcualte its energy in keV.

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64. A proton is travelling with horizontal velocity $v_x = 2 \cdot 5 \times 10^8 cms^{-1}$. Calculate the transverse deflection in travelling horizontal distance, $x = 5cm$ in electric field of $E_y = 400V/cm$. Mass of proton, $m = 1 \cdot 6 \times 10^{-24} g$, charge on proton, $e = 1 \cdot 6 \times 10^{-19} C$.

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65. An electron of energy $2000eV$ describes a circular path in magnetic field of flux density $0 \cdot 2T$. What is the radius of the path? Take $e = 1 \cdot 6 \times 10^{-19} C, m = 9 \times 10^{-31} kg$.

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

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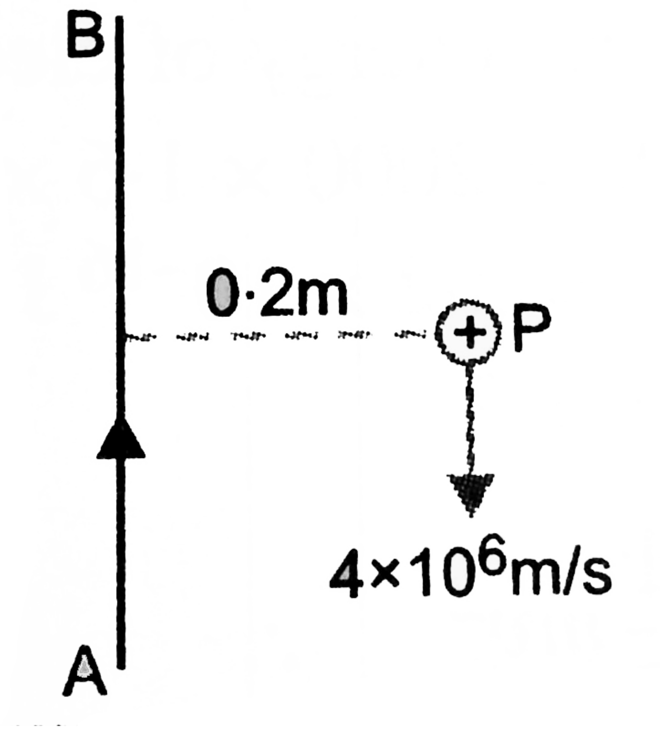
67. A long straight wire AB carries a current of $4A$. A proton P travels at $4 \times 10^6 ms^{-1}$ parallel to the wire, $0 \cdot 2m$ from it and in a direction opposite to the current as shown in figure. Calculate the force which the magnetic field of current exerts on the proton.

Also specify the direction of the force.



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68. A solenoid of length $1 \cdot 5m$ has a radius of $1 \cdot 5cm$ and has a total of 1500 turns wound on it. It carries a current of $3A$. Calculate the magnetic of the axial magnetic field inside the solenoid. If an electron were to move with a speed of $2 \times 10^4 ms^{-1}$

along the axis of the current carrying solenoid, what would be the force experienced by this electron?

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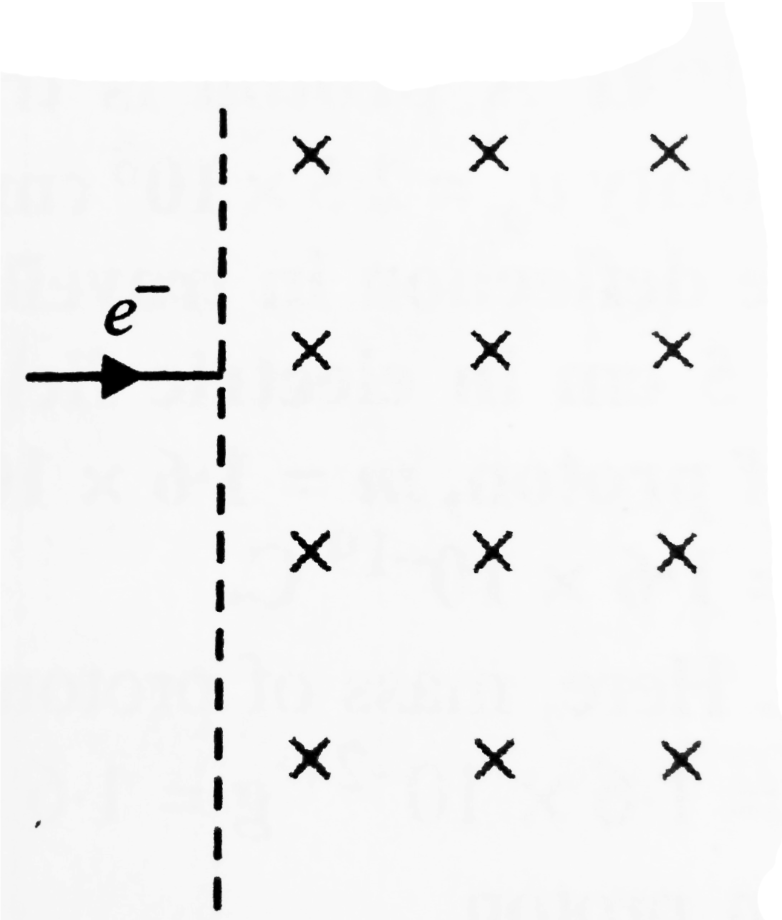
69. An electron moving horizontally with a velocity of $4 \times 10^4 ms^{-1}$ enters a region of uniform magnetic field of $10^{-5}T$, acting vertically downwards as shown in figure. Draw its trajectory and find out the time it takes to come out of the region of magnetic field.



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70. In a chambe of a uniform magnetic field of $8 \cdot 0G\left[1G = 10^{-4}T\right]$ is maintained. An electron with a speed of $4 \cdot 0 \times 10^6 ms^{-1}$ enters the chamber in a direction normal to the field

(i) Describe the path of electron.

(ii) What is the frequency of revolution of electron?

(iii) What happens to the path of the electron if it progressively loses its energy due to collisions with the atoms or molecules of the environment?

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71. A beam of electrons enters a uniform magnetic field of $0 \cdot 3T$ with a velocity of $4 \times 10^5 ms^{-1}$ at an angle of 60° to the field. Find the radius of the helical path taken by the beam. Also find the pitch of the helix (distance travelled by a proton parallel to the magnetic field during one period of rotation). Mass of proton is $1 \cdot 67 \times 10^{-27} kg$.

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72. A beam of alpha particle passes underflected with a horizontal velocity v, through a region of electric and magnetic fields, mutually perpendicular to each other and normal to the direction of the beam. If the mangnitude of the electric and magnetic fields are $120kVm^{-1}$ and $60mT$ respectively, calculate (i) velocity of the beam (ii) force with which it strikes a target on a screen, if the alpha particle beam current is equal to $1mA$? Mass of proton=mass of neutron $= 1 \cdot 675 \times 10^{-27}kg$.

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73. A cyclotron oscillator frequency is $10MHz$. What should be the operating magnetic field for accelerating protons? If the radius of its dees is $60cm$, what is the kinetic energy of the proton beam produced by the acceleration in MeV?

$\left(e = 1 \cdot 6 \times 10^{-19}C, m_p = 1 \cdot 67 \times 10^{-27}kg, 1MeV = 1 \cdot 6 \times 10^{-13}J\right)$

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74. An electron beam passes through a magnetic field of $4 \times 10^{-3} weber/m^2$ and an electric field of $2 \times 10^4 Vm^{-1}$, both acting simultaneously. The path of electron remaining undeviated, calcualte the speed of the electrons. If the electric field is removed, what will be the radius of the electron path?

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75. A cyclotron oscillator frequency is $10MHz$. What should be the operating magnetic field for accelerating α-particle? If the radius of the dees is $50cm$, what is the kinetic energy in MeV of the α-particle beam produced by the accelerator?

$\left(e = 1 \cdot 6 \times 10^{-19}C, m_\alpha = 4 \cdot 0028 a.m.u., 1 a.m.u. = 1 \cdot 66 \times 10^{-27}kg\right)$

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76. In a cycloton, the protons are to be accelerated with a magnitude field of magnitude $1 \cdot 5T$. How rapidly should the electric field between the dees be reversed? Mass and charge of proton are $1 \cdot 67 \times 10^{-27} kg$ and $1 \cdot 6 \times 10^{-19} C$ respectively.

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77. If the maximum value of accelerating potential provided by a radio frequency oscillator be $25kV$, find the number of revolutions made by a proton in a cyclotron to achieve one sixth of the speed of light. Mass of proton $= 1 \cdot 67 \times 10^{-27} kg$.

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78. The horizontal component of earth's magnetic field at a certain place is $3 \cdot 0 \times 10^{-5} T$ and the direction of the field is form 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 diection of the current is (a) east to west (b) south to north?

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79. A wire carrying a current $15A$ and of length $4 \cdot 0 cm$ is placed inside a solenoid near its centre making an angle of 60° with the axis of solenoid, where the magnitude of the magnetic field due to the solenoid is $0 \cdot 30 T$. What is the force on the wire?

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80. A straight wire $50cm$ long carries a current of $5A$. It is placed at right angle to a uniform magnetic field of $1T$. Find the mechanical force on the wire and the power required to move it at $10ms^{-1}$ in a plane at right angles to the magnetic field.

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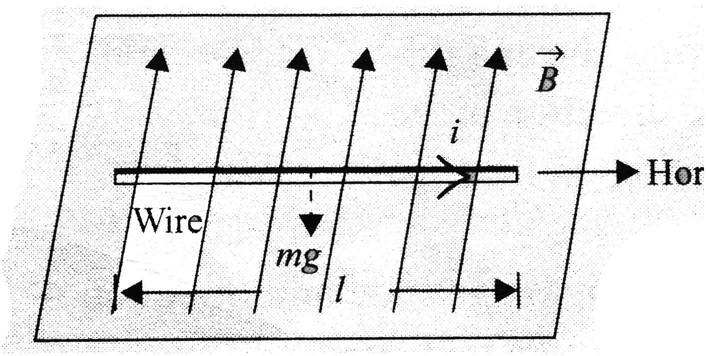
81. A straight wire of mass 200 g and length 1.5 m carries a current of 2 A. It is suspended in mid-air by a uniform horizontal magnetic field B. What is the magnitude of the magnetic field?



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82. A long straight conductor C carrying a current of $3A$ is placed parallel to a short conductor D of length $5cm$, carrying a current $4A$. The two conductors are $10cm$ apart. Find (i) the magnetic field due to C at D. (ii) The approximate force on D.

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83. A horizontal wire $0 \cdot 2m$ long carries a current of $4A$. Find the magnitude and direction of the magnetic field, which can support the weight of the wire. Given, the mass of the wire is $3 \times 10^{-3} kg/m$, $g = 10ms^{-2}$.

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84. A straight horizontal conducting rod of length $0 \cdot 60m$ and mass of $60g$ is suspended by two vertical wires at its ends. A current of $5 \cdot 0A$ is set up in the rod through the wire. (a) What magnetic field should be set up normal to the conductor in order that the tension in the wire is zero?

(b) What will be total tension in the wires if the direction of current is reversed, keeping the magnetic field same as before (Ignore mass of the wire), $g = 10ms^{-2}$.

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85. Calculate the force per unit length on a long straight wire carrying current $4A$ due to parallel wire carrying current $6A$ current. Distance between the wires $= 3cm$.

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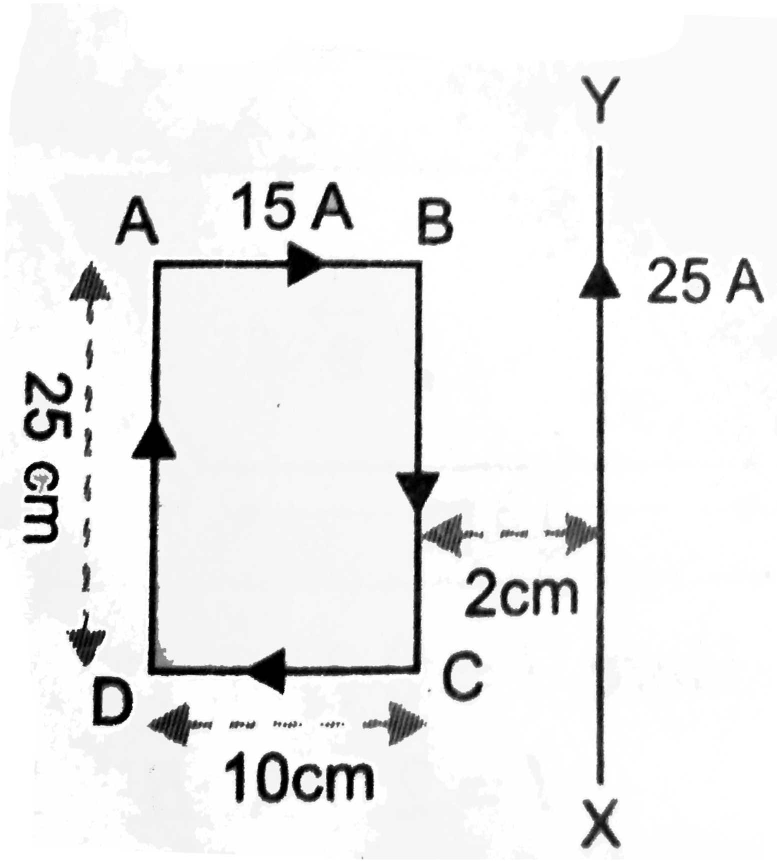
86. Figure shows a rectangular current-carrying loop placed $2cm$ away from a long, straight, current carrying conductor. What is the direction and magnitude of the net force acting on the loop?



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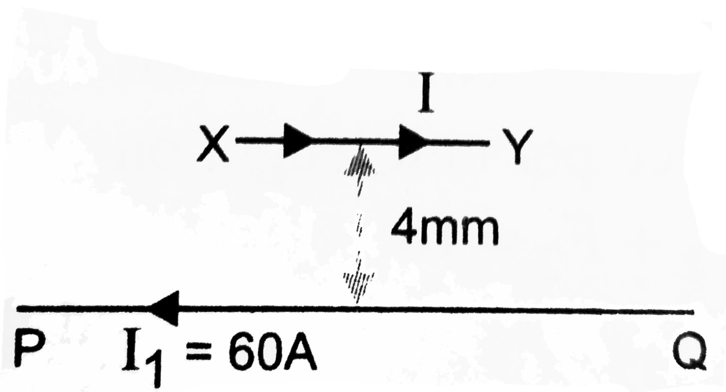
87. A long straight conductor PQ, carrying a current of $60A$, is fixed horizontally. Another long conductor XY is kept parallel to PQ at a distance of $4mm$, in air. Conductor XY is free to move and carries a current I. Calcualte the magnitude and direction of current I for which the magnetic repulsion just balances the weight of conductor XY. (Mass per units length for conductor XY is $10^{-2} kg/m$).



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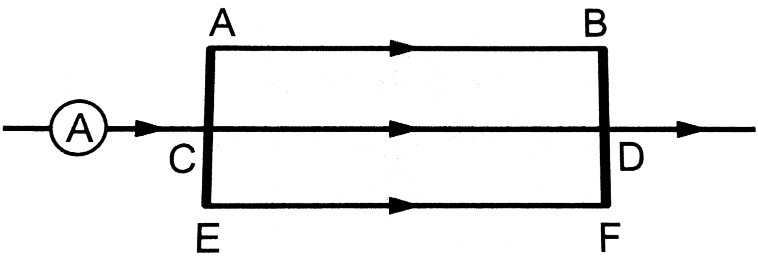
88. Figure shows a part of an electric circuit. The wires AB, CD, and EF are long and have identical resistances. The separation between the neighbouring wires is 1.0 cm. The wires AE and BF have negligible resistances and the ammeter reads 30 A . Calculate the magnetic force per unit length of AB and CD. `



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89. A wire AB is carrying a steady current of $12A$ and is lying on the table. Another wire CD carrying current $5A$ is held vertically above AB at a height of 1mm. Find the mass per unit length of the wire CD so that it remains suspended at the position when left free.

Give the direction of the current flowing in CD with respect to that in AB. $g = 10ms^{-2}$.

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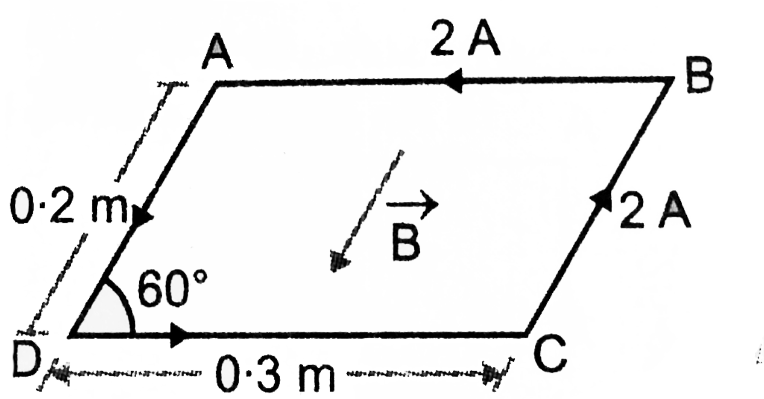
90. A parallelogram shaped coil ABCD of sides $0 \cdot 3m$ and $0 \cdot 2m$ carries a current of $2 \cdot 0A$ as shown in figure. It is placed in a uniform magnetic field $\vec{B} = 50T$ parallel to AD. Find (i) forces on the sides of the coil and (ii) torque on the coil.



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91. A square shaped plane coil of area $100cm^2$ of 200 turns carries a steady current of $5A$. It is placed in a uniform magnetic field of $0 \cdot 2T$ acting perpendicular to the plane of the coil. Calculate the torque on the coil when its plane makes an angle of 60° with the direction of the field. In which orientation will the coil be in stable equilibrium?

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92. A solenoid of length $0 \cdot 4m$ and having 500 turns of wire carries a current of $3A$. A thin coil having 10 turns of wire and of radius $0 \cdot 01m$ carries a current of $0 \cdot 4A$. Calculate the torque required to hold the coil in middle of the solenoid with its axis perpendicular to the axis of the solenoid.

$\left(\mu_0 = 4\pi \times 10^{-7} V - s/A - m\right)$

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93. A 100 turn closely wound circular coil of radius $10cm$ carries a current of $3 \cdot 2A$. (i) What is the field at the centre of the coil? (ii) What is the magnetic moment of this arrangement? The coil is placed in a vertical plane and is free to rotate about a horizontal axis which coincides with its diameter. A uniform magnetic field of $2T$ in the horizontal direction exists such that initially the axis of the coil is in the direction of the field. The coil rotates through an angle of 90° under the influence of the magnetic field. (iii) What are the magnitudes of the torques on the coil in the initial and final positions? (iv) What is the angular speed acquired by the coil when it has rotated by 90°? The moment of inertia of the coil is $0 \cdot 1kgm^2$.

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94. A rectangular coil of sides $8cm$ and $6cm$ haivng 2000 turns and carrying a current of $200mA$ is placed in a uniform magnetic field of $0 \cdot 2T$ directed along the positive x-axis. (a) What is the maximum torque the coil can experience? In which orientation does it experience the maximum Torque? (b) For which orientations of the coil is the torque zero? When is this equilibrium stable and unstable?

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95. A rectangular coil of area $5.0 \times 10^{-4}m^2$ and 60 turns is pivoted about one of its vertical sides. The coil is in a radial horizontal field of 90 G (radial here means the field liners are in the plane of the coil for any rotation). What is the torsional constant of the hair spring connected to the coil if a current of 2.0 mA produces an angular deflection of 18°?

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96. Compare the current sensitivity and voltage sensitivity of the following moving coil galvanometers:

Meters A : $n = 30, A = 1 \cdot 5 \times 10^{-3} m^2$,

$B = 0 \cdot 25T, R = 20\Omega$

Meter B: $n = 35, A = 2 \cdot 0 \times 10^{-3} m^2$,

$B = 0 \cdot 25T, R = 30\Omega$.

You are given that the springs in the two meters have the same torsional constants.

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97. A current of $300\mu A$ deflects a coil of a moving coil galvanometer through 30°. What should be the current to cause the rotation through $\pi/5$ radius? What is the current sensitivity of the galvanometer ? If resistance of galvanometer is 50Ω, find its voltage sensitivity.

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98. The current sensitivity of a moving coil galvanometer increases by 20% when its resistance is increased by a factor 2. Calculate by what factor does the voltage sensitivity change?

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99. A current of $500\mu A$ deflects the coil of a moving coil galvanometer through 60°. What should be the current to cause the rotation through $\pi/5$ radian? What is the sensitivity of galvanometer?

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100. When a galvanometer having 30 divisions scale and 100Ω resistance is connected in series with the battery of e.m.f. 3 volt through a resistance of 200Ω, it shows full scale deflection. Find the figure of merit of the galvanometer in microampere.

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101. A galvanometer with a scale divided into 100 equal divisions has a current sensitivity of 10 divisions per mA and a voltage sensitivity of 2 divisions per mV. What adoptions are required to read (i) $5A$ for full scale and (ii) 1 division per volt?

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102. A resistance of 1980Ω is connected in series with a voltmeter, after which the scale division becomes 100 times larger. Find the resistance of voltmeter.

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103. A galvanometer having 30 divisions has a current sensitivity of $20\mu A/division$. It has a resistance of 25Ω. How will you convert it into an ammeter upto 1 ampere? How will you convert this ammeter into a voltmeter up to 1 volt?

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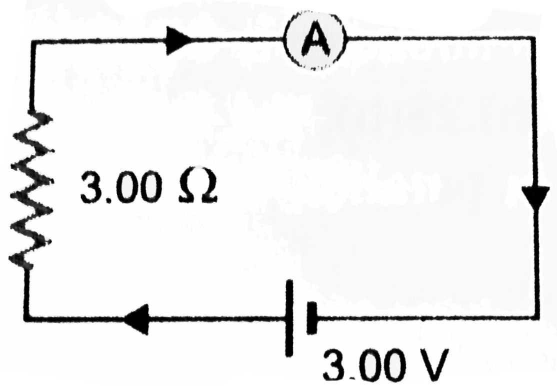
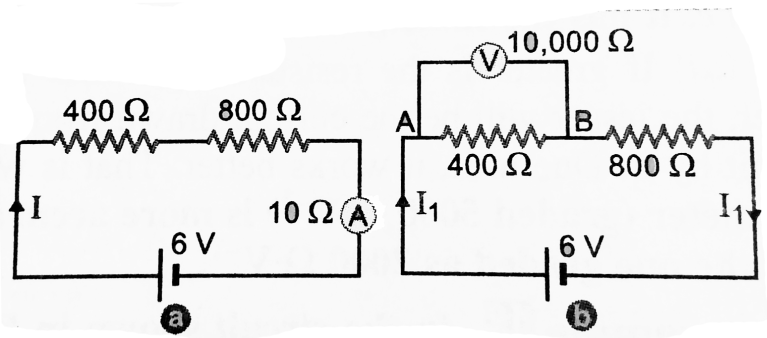
104. A galvanometer reads $5 \cdot 0V$ at full scale deflection and is graded according to its resistance per volt at full scale deflection as $5000\Omega V^{-1}$. (i) How will you convert it into a voltmeter that reads $20V$ at full scale deflection? (ii) Will it still be graded $5000\Omega V^{-1}$? (iii) Will you prefer this voltmeter to one that is graded $2000\Omega V^{-1}$?

105. In the circuit shown in figure, the current is to measured. What is the value of the current if the ammeter shown (i) is a galvanometer with a resistance $R_G = 60 \cdot 00 \Omega$. (ii) is a galvanometer described in (i) but converted to an ammeter by a shunt resistance $r_s = 0 \cdot 02 \Omega$, (iii) is an ideal ammeter with zero resistance?



106. Two resistors 400Ω and 800Ω are connected in series with a $6V$ battery. It is desired to measure the current in the circuit. An ammeter of 10Ω resistance is used for this purpose figure. What will be the reading in the ammeter? Similarly, if a voltmeter of $10,000\Omega$ resistance is used to measure the potential difference across the 400Ω resistor, what will be the reading in the voltmeter?



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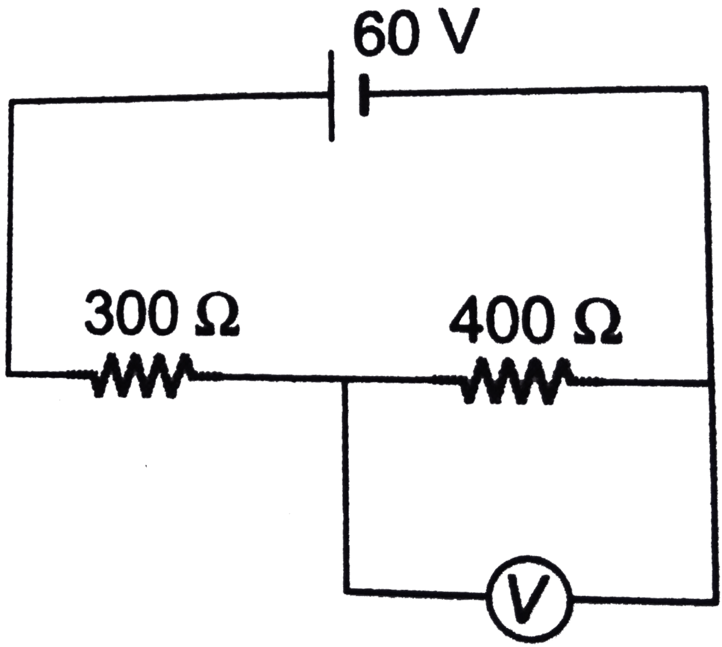
107. In the circuit, a voltmeter reads $30V$ when it is connected across 400 Ω resistance. Calculate what the same voltmeter will read when it is connected across the 300Ω resistance?



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108. Two unlike magnetic poles of strength $10A - m$ each are held in air at a distance of $0 \cdot 5m$ from each other. What is the magnetic force of attraction between them?

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109. A magnet $2cm$ long has a pole strength of $60Am$. Find the magnitude of magnetic field strength B at a point on its axis at a distance of $20cm$ from it. What would be the value of B, if the point were to lie at the same distance on equatorial line of magnet?

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110. Calculate the magnetic field due to a bar magnet $2cm$ long and having pole strength of $100A - m$ at a point $10cm$ from each pole.

Watch Video Solution

111. A wire of length $Lmetre$, carrying a current Iampere is bent in the form of a circle . The magnitude of its magnetic moment is

.... $MKSunits$.

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112. A bar magnet having a magnetic moment of $1.0 \times 10^4 JT^{-1}$ is free to rotate in a horizontal plane. A horizontal magnetic field $B = 4 \times 10^{-5} T$ exists in the space. Find the work done in rotating the magnet slowly from a direction parallel to the field to a direction 60° from the field.

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113. Calculate the magnitude of torque required to hold a bar magnet of magnetic moment $200 Am^2$ along a direction making an angle of 30° with the direction of uniform magnetic field of $0 \cdot 36G$.

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114. A bar magnet having a magnetic moment of $1.0 \times 10^{4} JT^{-1}$ is free to rotate in a horizontal plane. A horizontal magnetic field $B = 4 \times 10^{-5} T$ exists in the space. Find the work done in rotating the magnet slowly from a direction parallel to the field to a direction 60° from the field.

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115. At a place, the horizontal component of earth's magnetic field is B and angle of dip is 60°. What is the value of horizontal component of earth's magnetic field at equator?

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116. The horizontal component of earth's magnetic field at a place is $0 \cdot 4 \times 10^{-4} T$. If angle of dip 45°, what are the values of vertical component and total field strength of earth's field?

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117. A short bar magnet is placed with its north pole pointing south. The neutral point is $10 cm$ away from the centre of the magnet. If $H = 0 \cdot 4$ gauss, calculate magnetic moment of the magnet.

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118. A short bar magnet is placed with its north pole pointing north. If magnetic moment of magnet is $0 \cdot 4 Am^2$ and horizontal component of earth's magnetic field is $0 \cdot 4$ gauss, what is the distance of neutral point from the centre of the magnet?

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119. The radius of the coil of a tangent galvanometer is $16cm$. How many turns of the wire should be used if a current of $40mA$ is to produce a deflection of 45°. Given, horizotnal component of earth's field is `0*36xx10^-4T.

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120. Two short magnets having magnetic moments in the ratio $8:1$, when placed on opposite sides of a deflection magnetometer produce no deflection. If distance of stronger magnet from the centre of deflection magnetometer is $6cm$, what is the distance of weaker magnet from the centre?

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121. A magnetic dipole of length $15cm$ has a dipole moment of $1 \cdot 5Am^2$. What is the pole of strength?

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122. A magnetised steel wire $31.4cm$ long has a pole strength of $0 \cdot 2Am$. It is bent in the form of a semicircle. Calcualte its magnetic moment.

Watch Video Solution

123. Two similar magnetic poles, having pole strengths in the ratio $1:2$ are placed $1m$ apart. Find the point where a unit pole experiences no net force due to the two polese.

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124. Two identical thin bar magnets, each of length L and pole strength m are placed at right angles to each other, with the N pole of one touching the S-pole of the other. Find the magnetic moment of the system.

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125. Two magnetic poles, one of which is four times stronger than the other, exert a force of $10gf$ on each other, when placed at a distance of $10cm$ in air. Find the strength of each pole.

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126. Calculate the force acting between two magnets of length $15cm$ each and pole strength $80Am$ each when the separation between their north poles is $10cm$ and that between south poles is $40cm$.

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127. Two magnetic poles exert a force equal to $2kg$ f on each other, when placed at a distance of $4cm$ in air. If strength of one pole is eight times the strength of the other pole, what is the strength of stronger pole? (Take $g = 10m/s^2$)

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128. The magnetic moment of a current carrying loop is $2.1 \times 10^{-25} amp \times m^2$. The magnetic field at a point on its axis at a distance of 1Å is

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129. Two identical magnetic dipoles of magnetic moments $1 \cdot 0Am^2$ each are placed at a separation of $2m$ with their axes perpendicular to each other. What is the resultant magnetic field at a point midway between the dipoles?

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130. The earth's magnetic field at the equator is approximately $0 \cdot 4G$, Estimate the earth's dipole moment.

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131. What is the magnitude of the equatorial and axial fields due to a bar manget of length $5 \cdot 0cm$ at a distance of $50cm$ from its mid-point? The magnetic moment of the bar magnet is $0 \cdot 40Am^2$.

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132. Two short magnets P and Q are placed one over another with their magnetic axes mutually perpendicular to each other. It is found that resultant magnetic field at a point on the prolongation of magnetic axis of P is inclined at 30° with this axis. Compare the magnetic moments of the two magnets.

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133. A circular coil of 300 turns and diameter $14cm$ carries a current of $15A$. What is the magnitude of magnetic moment linked with the loop?

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134. An electron in an atom revolves around the nucleus in an orbit of radius $0 \cdot 5 \text{Å}$. Calculate the equivalent magnetic moment if the frequency of revolution of electron is $10^{10} MHz$

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135. A planar loop of irregular shape encloses an area of $7 \cdot 5 \times 10^{-4} m^2$, and carries a current of $12A$. The sense of flow of current appears to be clockwise to an observer. What is the magnitude and direction of the magnetic moment vector associated with the current loop?

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136. A loop of wire having 50 turns carries a current of $10A$ in anticlockwise direction. If diameter of loop is $10cm$, what is the magnitude and direction of magnetic moment of current loop?

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137. A short bar magnet placed with its axis at 30° to a uniform magnetic field of $0 \cdot 2T$ experiences a torque of $0 \cdot 06N - m$. Calculate magnetic moment of the magnet. What orientation of magnet corresponds to its stable equilibrium in the magnetic field?

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138. An electron moves around the nucleus in a hydrogen of radius $0 \cdot 51\text{Å}$ with a velocity of $2 \times 10^6 m/s$. Calculate (i) the equivalent current due to orbital motion, (ii) magnetic field produced at the centre of nucleus. (iii) magnetic moment associated with electron.

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139. A short bar magnet of magnetic moment $0 \cdot 9JT^{-1}$ is placed with its axis at 30° to a uniform magnetic field. It experiences a torque of $0 \cdot 063J$. Calculate the magnitude of magnetic field. In which orientation will the bar magnet be in stable equilibrium in the magnetic field?

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140. A straight solenoid of length $50cm$ has 1000 turns and a mean cross sectional area of $2 \times 10^{-4}m^{2}$. It is placed with its axis at 30° with a uniform magnetic field of $0 \cdot 31T$. Find the torque acting on the solenoid when a current of $2A$ is passed through it.

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141. A bar magnet when suspended horizontally and perpendicular to earth's field experiences a torque of $3 \times 10^{-4} Nm$. What is the magnetic moment of the magnet? Horizontal component of earth's magnetic field at that place is $0 \cdot 4 \times 10^{-4} tesla$.

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142. A circular coil of 100 turns and having an effective radius of $5cm$ carries a current of $0 \cdot 1$ ampere. How much work is required to turn it in an external magnetic field of $1 \cdot 5 weber/m^2$ through 180° about an axis perpendicular to magnetic field. The plane of the coil is initially perpendicular to the magnetic field.

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143. A current of $5A$ is flowing through a 10 turns circular coil of radius $7cm$. The coil lies in x-y plane. What is the magnitude and direction of dipole moment associated with it?

If this coil were placed in a uniform external magnetic field directed along the x-axis, in which plane would be coil lie in equilibrium?

$\pi = 22/7$.

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144. A current of $7 \cdot 0A$ is flowing in a plane circular coil of radius $1 \cdot 0cm$ having 100 turns. The coil is placed in a uniform magnetic field of $0 \cdot 2Wb/m^2$. If the coil is free to rotate, what orientation would correspond to its (i) stable equilibrium and (ii) unstable equilibrium? Calculate potential energy of the coil in the two cases.

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145. A compass needle whose magnetic moment is $60Am^2$ pointing geographic north at a certain place where horizontal component of earth's magnetic field is $40\mu Wb/m^2$ experiences a torque of $1 \cdot 2 \times 10^{-3}Nm$. What is the declination of the place?

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146. The true value of dip at a place is 45°. If the vertical plane carrying the needle is turned through 60° from the magnetic meridian, find the inclination of the needle (i.e. what will be the apparent value of dip)?

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147. A magnetic needle free to rotate in a vertical plane parallel to the magnetic meridian has its north tip down 60° with the horizotnal. The horizontal component of earth's magnetic field at the place is $0 \cdot 4G$. Determine the magnitude of earth's magnetic field at the place.

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148. The magnetic field at a point on magnetic equator is $3 \cdot 1 \times 10^{-5} T$. If radius of earth is taken as $6400 km$, what is magnetic moment of the assumed dipole at the centre of earth?

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149. A ship is to reach a place 10° south of west. In what direction should it be steered if declination at the place is 17° west?

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150. Horizontal component of earth's magnetization at a place is $3 \cdot 6 \times 10^{-5} T$, and dip of the place is $60^{\circ} N$. Obtain the vertical component and total intensity of earth's magnetization.

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151. The real angle of dip, if a magnet is suspended at an angle of 30° to the magnetic meridian and the dip needle makes an angle of 45° with horizontal, is:

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152. In the magnetic meridian of a certain place, the horizontal component of the earth's magnetic field is $0 \cdot 26 G$ and dip angle is

60°. What is the magnetic field of earth at this location?

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153. If the horizontal component of earth's magnetic field at a place where the angle of dip is 60° is $0 \cdot 4 \times 10^{-4} T$, calculate the vertical component and the resultant magnetic field at that place.

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154. At a certain place, a compass, needle point 14° east of north. If dip at the place is 30° and horizontal component of earth's field is $0 \cdot 32$ gauss, what is earth's resultant field at that place?

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155. Calculate the horizontal component of earth's magnetic field at place, where angle of dip is 30°. Given vertical component of earth's field at the place is $0 \cdot 12\sqrt{3} \times 10^{-4} T$.

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156. A neutral point is found on the axis of a bar magnet at a distance of $10cm$ from one end. If the length of the magnet is $10cm$ and $H = 0 \cdot 3gauss$, find the magnetic moment of the magnet.

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157. A short bar magnet of magnetic moment $0 \cdot 5JT^{-1}$ is placed with its magnetic axis in magnetic meridian, with its north pole pointing geographic north. A neutral point is obtained at a distance of $0 \cdot 1m$ from the centre of the magnet. Find the horizontal component of earth's magnetic field.

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158. A small bar magnet has a magnetic moment $5Am^2$. The neutral point is obtained on axial line when it is placed in magnetic meridian with its N pole pointing S of earth and neutral point is obtained on equatorial line, when it is placed with its N pole pointing towards north of earth. If horizontal component of earth's field is $0 \cdot 38G$, find the position of neutral points in the two cases.

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159. The magnetic moment of a short bar magnet is $1 \cdot 6Am^2$. It is placed in the magnetic meridian with north pole pointing south.

The neutral point is obtained at $20cm$ from the centre of the magnet. Calculate the horizontal component H of earth's field. If magnet be reversed i.e. north pole pointing north, find the position of the neutral point.

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160. A magnet placed in the magnetic meridian with its north pole pointing north of the earth produces a neutral point at a distance of $0 \cdot 15m$ from either pole. It is then broken into two equal parts and one such piece is placed in a similar position. Find the position of the neutral point.

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161. Two tangent galvanometers A and B have coils of radii $8cm$ and $16cm$ respectively and resistance $8ohm$ each. They are connected in parallel to a cell of emf $4V$ and negligible internal resistance. The deflections produced are 30° and 60° respectivley. A has 2 turns. What is the number of turns in B?

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162. Two short magnets having magnetic moments in the ratio $27:8$, when placed on opposite sides of a deflection magnetometer produce no deflection. If the distance of weaker magnet is $0 \cdot 12m$ from the centre of deflection magnometer, what is the distance of stronger magnet from the centre?

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163. In a tangent galvanometer, when a current of $10mA$ is passed, the deflection is 31°. By what percentage, the current has to be increased, so at to produce a deflection of 42°?

Watch Video Solution

164. The coil in a tangent galvanometer is $16cm$ in radius. How many turns of the wire should be wound on it if a current of $20mA$ is to produce a deflection of 45°? Take horizontal component of earth's field $= 0 \cdot 36 \times 10^{-4}T$.

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165. A current carrying planar loop suspended in a vertical plane normal to magnetic meridian is in stable equilibrium. The horizontal component of earth's magnetic field is $0 \cdot 32G$. Another horizontal magnetic field of magnetude $0 \cdot 48G$ parallel to the plane of the loop is set up along magnetic west to east. Specify the new stable equilibrium.

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166. A short bar magnet placed with its axis at 30° experiences a torque of $0 \cdot 016 N - m$ in an external field of $800 G$.

(a) What is the magnetic moment of the magnet? (b) What is the work done by an external force in moving it from its most stable to most unstable position? (c) What is the work done by force due to external magnetic field in the process mentioned in (b)? (d) The bar magnet is replaced by solenoid of cross sectional area $2 \times 10^{-4} m^2$ and 1000 turns, but the same magnetic moment. Determine the current flowing through the solenoid.

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167. A magnetic needle has magnetic moment of $6 \cdot 7 \times 10^{-2} Am^2$ and moment of inertial of $7 \cdot 5 \times 10^{-6} kgm^2$. It perform 10 complete oscillations in $6 \cdot 70s$. What is the magnitude of the magnetic field?

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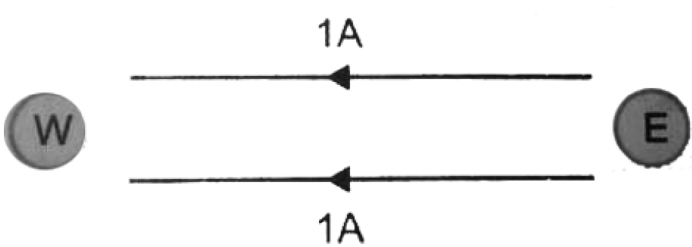
168. Two conductors carrying $1A$ current each along east to west are held as shown in figure. The magnetic declination at the place is almost zero and angle of dip is 45°. The total intensity of earth's magnetic field at the place is $0 \cdot 32$ gauss. Calculate magnetic field at points $0 \cdot 04m$ below and above the two conductors.



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169. A bar magnetic made of steel has a magnetic moment of $2 \cdot 5Am^2$ and a mass of $6 \cdot 6g$. If density of stell is $7 \cdot 9 \times 10^{-3} kg/m^3$, what is the intensity of magnetisation?

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170. An iron rod of $0 \cdot 2cm^2$ cross-sectional area is subjected to a magnetising field of $1200Am^{-1}$. The suscaptibility of iron is 599. Find the responsibility and the magnetic flux produced.

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171. Effective dipole moment of a paramagnetic salt is $4 \cdot 5 joule/tesla$ at $4 \cdot 2K$ under magnetic field of $0 \cdot 8T$. Find magnetic moment at $2 \cdot 8K$, when magnetic field is $1T$. Assume Curie's Law.

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172. The hyterisis loss for a sample of $12kg$ is $300Jm^{-3}cycle^{-1}$. If density of iron is $7500kg/m^3$, calculate energy loss per hour at $50cycle/\sec$.

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173. An electron in a helium atom is revolving in the first orbit with a speed of $4 \cdot 5 \times 10^6 m/s$. If radius of orbit is $0 \cdot 26 Å$, what is the magnetic moment of the electron?

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174. In a hydrogen atom, the electron moves in an orbit of radius $0 \cdot 5\text{Å}$, making $10^{16} rps$. Calculate the magnetic moment associated with the orbital motion of electron.

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175. The electron in a hydrogen atom is moving with a speed of $2 \cdot 3 \times 10^6 ms^{-1}$ in an orbit of radius $0 \cdot 53\overset{o}{A}$. Calculate the magnetic moment of revolving electron.

Watch Video Solution

176. An electron moves around the nucleus in a hydrogen of radius $0 \cdot 51\text{Å}$ with a velocity of $2 \times 10^6 m/s$. Calculate (i) the equivalent current due to orbital motion, (ii) magnetic field produced at the centre of nucleus. (iii) magnetic moment associated with electron.

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177. An electron in an atom revolves around the nucleus in an orbit of radius $0 \cdot 5\text{Å}$. Calculate the equivalent magnetic moment if the frequency of revolution of electron is $6 \cdot 8 \times 10^9 MHz$.

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178. The core of a toroid having $3000 turns$ has inner and outer radii of $11 cm$ and $12 cm$ respectively. The magnetic field in the core for a current of $0 \cdot 70 A$ is $2 \cdot 5 T$. Calculate relative permeability of the core?

Watch Video Solution

179. The coercivity of a certain permanent magnet is $4 \cdot 0 \times 10^4 Am^{-1}$. This magnet is placed inside a solenoid $15cm$ long and having $600 turns$. Calculate the current required to demagnetise the magnet completely.

Watch Video Solution

180. A toroidal solenoid has 3000 turns and a mean radius of $10cm$. It has a soft iron core of relative magnetic permeability 2000. Find the magnitude of the magnetic field in the core when a current of $1.0 amp$. is passed through the solenoid.

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181. A magnetic field of $1600 Am^{-1}$ produces a magnetic flux of $2 \cdot 4 \times 10^{-5}$ weber in a bar of iron of cross section $0 \cdot 2cm^2$.

Calculate permeability and susceptibility of the bar.

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182. A solenoid of $500 turns$ per meter is carrying a current of $3A$. Its core is made of iron, which has a relative permeability of 5000. Determine the magnitudes of magnetic intensity, intensity of magnetization and magnetic field inside the core.

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183. A solenoid has a core of a material with relative permeability 400. The windings of the solenoid are insulated from the core and carry a current of $2A$. If the number of turns is 1000 per metre, calculate (i) H (ii) B (iii) Intensity of magnetisation I, and the magnetising current.

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184. An ideal solenoid having $2000 turns$ per meter has an iron core of permeability 500 and carries a current of $1 \cdot 0A$. Calculate (i) magnetising itensity (H) at the centre of solenoid (ii) magnetic permeability of iron (iii) magnetic susceptibility of iron (v) intesity of magnetisation.

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185. An iron atom has a dipole moment of $9 \times 10^{24} Am^2$. Density of iron is $8g/cm^3$ and molecular mass is $55gmo \leq^{-1}$. If domain size of iron is a cube of side $10^{-6}m$ find (i) number of atoms in the domain (ii) maximum dipole moment (iii) intensity of magnetisation.

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186. The magnetic permeability of a substance is $7 \cdot 5 \times 10^{-3} TmA^{-1}$. Find relative permeability and magnetic susceptibility of the substance.

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187. A toroidal electromagnet has 1000 turns and mean radius of $0 \cdot 1m$. The magnetic core has a relative permeability of 2000. If a current of $1A$ is placed. Calculate the magnetic induction.

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188. Find the percent increase in the magnetic field B when the space within a current- carrying toroid is filled with aluminium. The susceptibility of aluminium is 2.1×10^{-5}.

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189. A bar of $5 \times 10^{-3} m^2$ area is subjected to a field of $600 Am$. If susceptibility of material is 499, calculate (i) permeability (ii) flux density and (iii) magnetic flux.

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190. The susceptibility of magnesium at $300K$ is $1 \cdot 2 \times 10^{-5}$. What will be susceptibility be when temperatures is increased to $400K$?

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191. A specimen of iron weighing $6kg$ loses $8 \cdot 64 \times 10^4 J$ of energy per hour when subjected to $50c/s$ a.c. If density of iron is $6000km/m^3$, what is the hysterisis loss per unit volume per cycle?

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192. Find curie constant for a sample from χ versus $1/T$ graph shown in figure.

Watch Video Solution

193. The susceptibility of magnetisium at $300K$ is $1 \cdot 2 \times 10^{-5}$. At what temperature will the susceptibility be equal to $1 \cdot 44 \times 10^{-5}$?

Watch Video Solution

194. Hysterisis loss for a sample of $120kg$ is $300Jm^{-3}/cycle$. Frequency of supply is $50cycle/s$. If density of iron is $7500kg/m^3$, find energy loss in 60 minutes.

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195. When temperature of a ferromagnetic material is increased by 10%, what is the percentage change in its magnetic susceptibility?

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196. A domain in ferromagnetic iron is in the form of a cube of side length $10^{-4}m$. Estimate the number of iron atoms in the domain and the maximum possible dipole moment and magnetisation of the domain. The molecular mass of iron is $55g/\text{mole}$, and its density is $7 \cdot 9g/cm^3$. Assume that each iron atom has a dipole moment of $9 \cdot 27 \times 10^{-24}Am^2$.

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197. An iron sample weighing $8 \cdot 4kg$ is taken through repeated cycles of magnetisation and demagnetisation at a frequency of $50c/s$. In 30 minutes, energy dissipated as heat in the sample is $3 \cdot 2 \times 10^4 J$. If density of iron is $7200kg/m^3$, what is the energy dissipated per unit volume per cycle?

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198. How is a magnetic field produced?

Watch Video Solution

199. How will you identify whether the magnetic field at a point is due to the earth or due to some current carrying conductor?

Watch Video Solution

200. The net charge in a current-carrying conductor is zero, even then it experiences a force in a magnetic field. Why?

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201. There is a thin conducting wire carrying current. What is the value of magnetic field induction at any point on the conductor itself?

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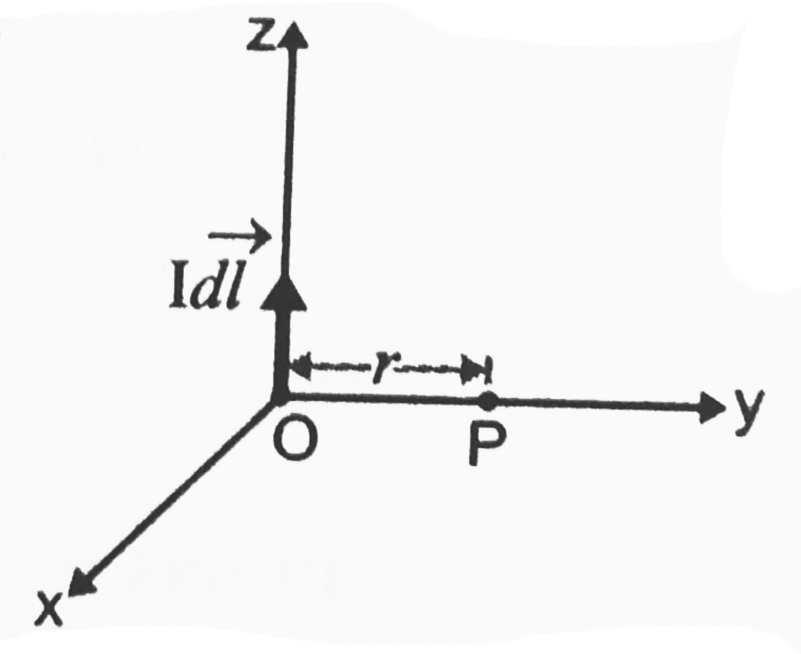
202. A current I flows in a conductor placed perpendicular to the plate of the paper. Indicate the direction of the magnetic field due to a small element $d\vec{l}$ at point P situated at a distance $\vec{r}$ from the element as shown in the figure.



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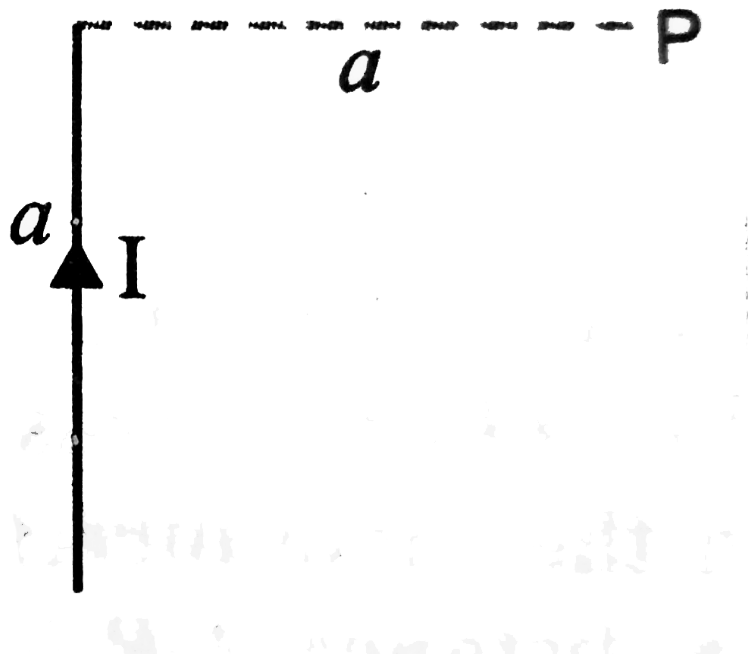
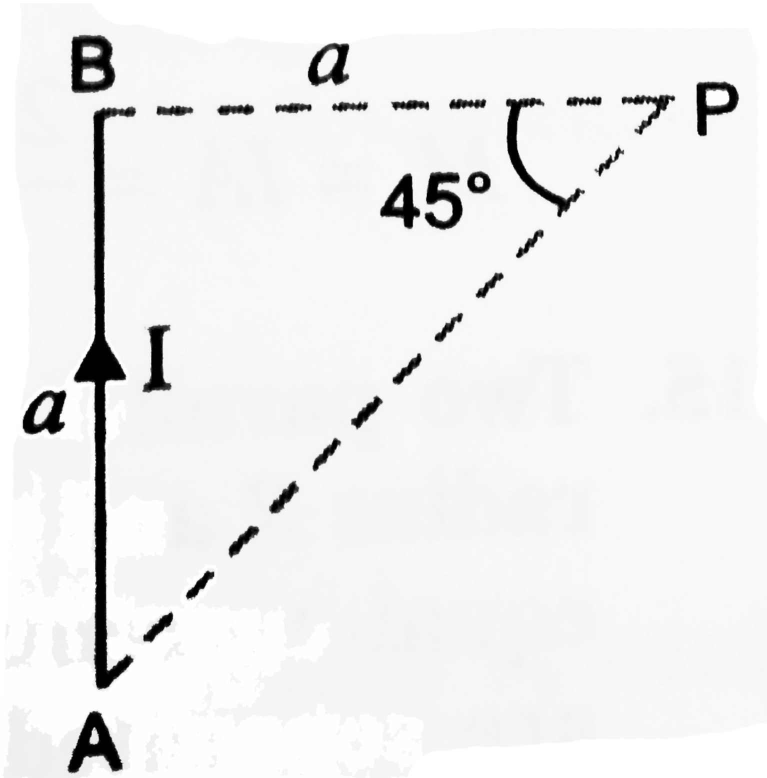
203. Compare the electrostatic field given by Coulomb's law and magnetic field given by Biot Savart's law.

Watch Video Solution

204. Figure shows a straight wire of length a carrying a current I. What is the magnitude of magnetic field induction produced by the current at P, which is lying at a perpendicular distance a from one end of the wire.


P
a
a
I


B
a
P
45°
I
a
A

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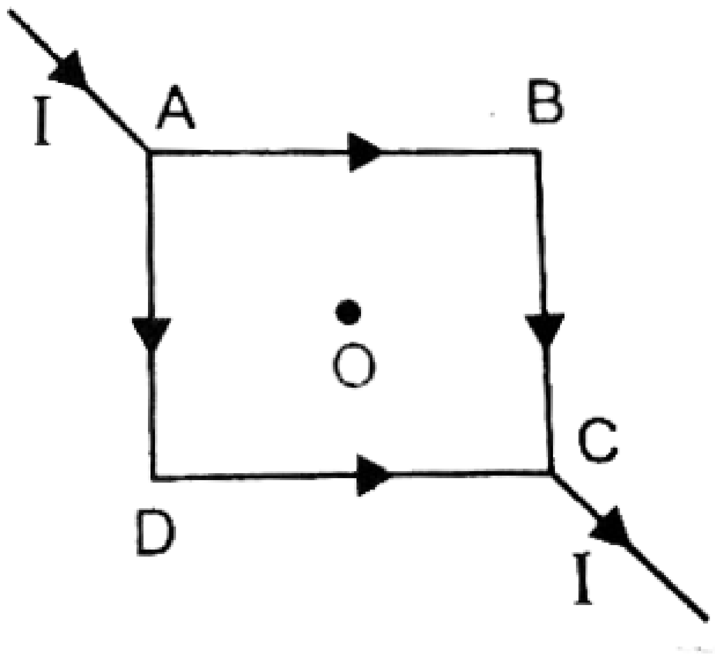
205. Figure shows a square loop made from a uniform wire. If a battery is connected between the pionts A and C. What will be the magnetic field at the centre O of the square?



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206. A closed circuit is in the form of a regular hexagon of side r. If the circuit carries current I, what is the magnetic field induction at the centre of the hexagon?

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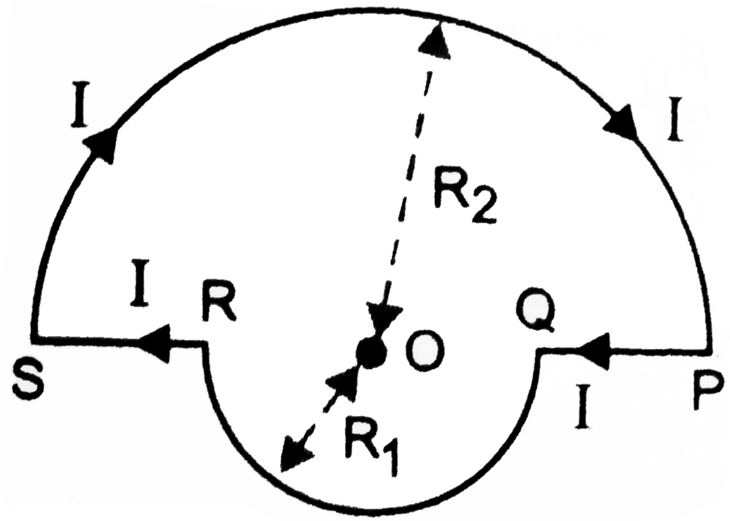
207. What do yo understand by magnetic dipole moment of the current loop.

Watch Video Solution

208. What is the magnetic moment of an electron orbiting in a circular orbit of radius r with a speed v?

Watch Video Solution

209. A wire loop formed by joining two semicircular wires of radii R_1 and R_2 carries a current I as shown in figure. Find the magnetic field induction at the centre O.



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210. 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

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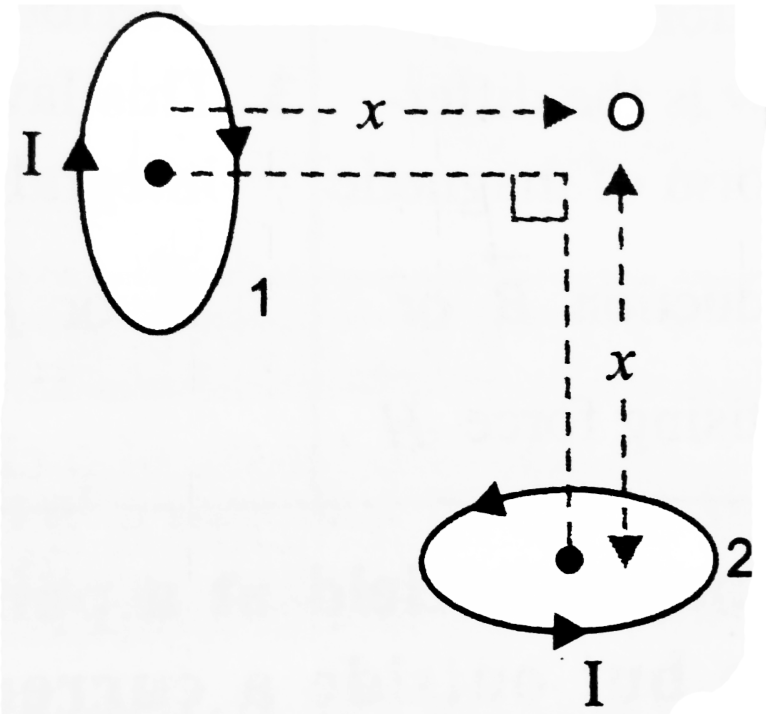
211. Magnetic induction produced at the centre of a circular loop carrying current is B . The magnetic moment of the loop of radius R is

(Me = permeability of tree space)

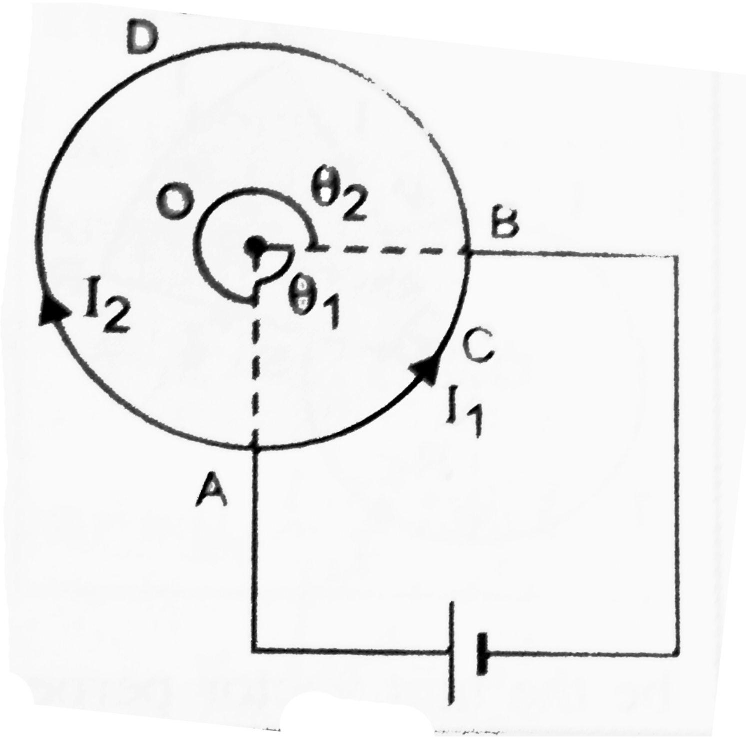
Watch Video Solution

212. Two parallel coaxial circular coils of equal radius R and equal number of turns N carry equal currents I in the same direction and are separated by a distance $2R$. Find the magnitude and direction of the net magnetic field produced at the mid-point of the line joining their centres.

213. Two small circular loops, marked (1) and (2), carrying equal currents are placed with the geometrical axes perpendicular to each other as shown in figure. Find the magnitude and direction of the net magnetic field produced at the point O.



214. As shown in figure a cell is connected across two points A and B of a uniform circular conductor of radius r. Prove that the magnetic field induction at its centre O will be zero.



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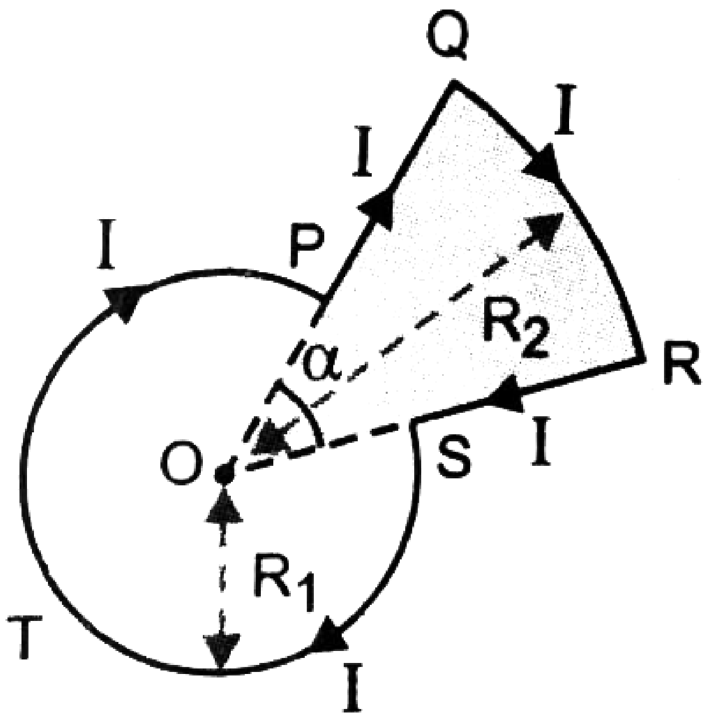
215. The circular loop PQRSTP formed by two circular segments of radii R_1 and R_2, carries a current I. What is the magnetic field induction at the centre O? What will be the magnetic field induction at O if $\alpha = 90^\circ$?



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216. How will the magnetic field induction at the centre of a circular coil carrying current change, if the current through the coil is doubled and the radius of the coil is halved?

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217. Distinguish between Biot Savart's law and Ampere's circuital law.

Watch Video Solution

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

Watch Video Solution

219. A hollow cylindrical conductor of inner radius a and outer radius b carries a current I uniformly spread over its cross-section. Find the magnetic field induction at a point inside the body of the

conductor at a distance r [where $a < r < b$] from the axis of the cylinder.

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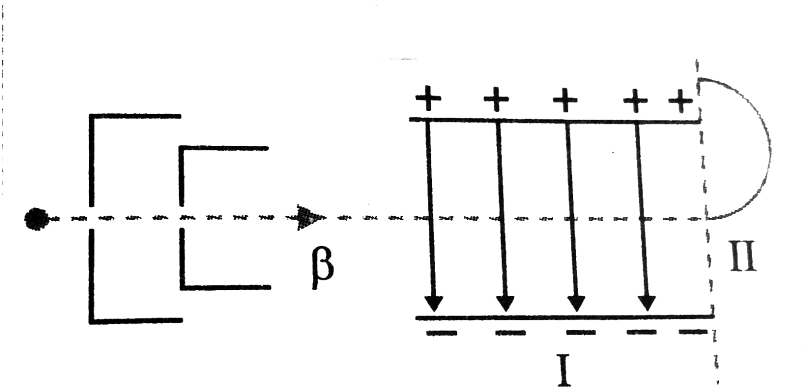
220. A fine pencil of β-particles, moving with a speed v, enters a region (region I), where a uniform electric field and a uniform magnetic field are both present. These β-particles then move into region II where only the magnetic field, (out of the two fields present in region I) exists. The path of the β-particles, in the two regions is as shown in the figure.



(i) state the direction of magnetic field.

(ii) state the relation between E and B in region I.

(iii) Drive the expression for the radius of the circular path of the β-particle in region II.

(iv) If the magnitude of magnetic field, in region II is changed to n times its earlier value, (without changing the magnetic field in region I) find the factor by which the radius of this circular path would change.

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221. Describe qualitatively the path of a charged particle moving in a region with uniform electrosatic and magnetic fields parallel to each other, with initial velocity (i) parallel (ii) perpendicular (iii) at an arbitrary angle with common direction of the fields.

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222. A charged particle q moving in a straight line is accelerated by a potential difference V. It enters a uniform magnetic field B perpendicular to its path. Deduce in terms of V an expression for the radius of the circular path in which it travels.

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223. You are sitting in a room in which uniform magnetic field is present in vertically downward direction. At the centre of room an electron is projected horizontally with a certain speed. Discuss the speed and path of the electron in this field.

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224. An electron is passing through a field but no force is acting on it. Under what conditions is it possible, if the motion of the electron be in the (i) electric field (ii) magnetic field?

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225. Both, the electric and magnetic fields can deflect a moving electron. What is the difference between these deflections?

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226. The energy of a charged particle moving in uniform magnetic field does not change-Explain.

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227. An eletron beam is deflected in a given field. How will you detect whether the given field is a uniform magnetic field or a uniform electric field?

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228. In what ways electric and magnetic fields are different?

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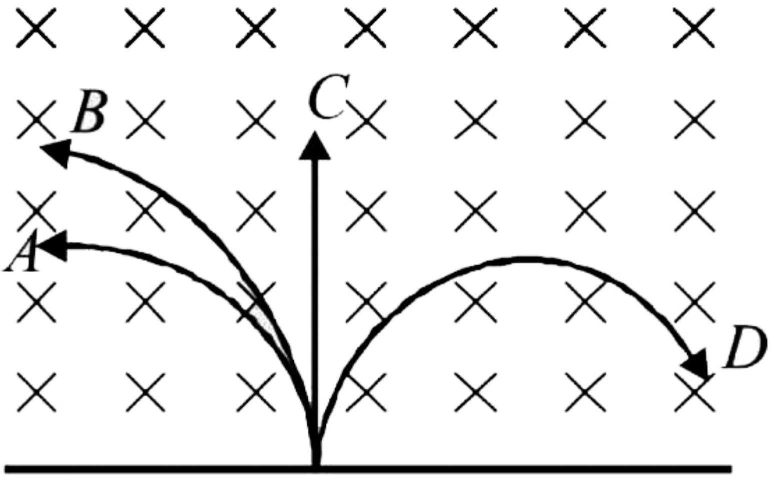
229. A neutron, a proton , and an electron and an alpha particle enter a region of constant magnetic field with equal velocities . The magnetic field is along the inward normal to the plane of the paper . The tracks of the particles are labelled in fig. the electron follows track .... and the alpha particle follows track.....



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230. Differentiate between electric and magnetic forces.

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231. A charged particle enters a (non-uniform) magnetic field varrying from point to point, both in magnitude and direction,

with a certain initial velocity. What do you say about the final velocity of the particle when it leaves the field?

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232. A straight horizontal conducting rod of length l and mass m is suspended by two vertical wires at its ends. A current I is set up in the rod through the wires.

(i) What magnetic field should be set up normal to the conductor in order that the tension in the wires is zero.

(ii) What will be the total tension in the wires if the direction of current is reversed, keeping the magnetic field same as before?

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233. Two parallel wires carrying current in the same direction attract each other while two beams of electrons travelling in the same direction repel each other. Why?

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234. An electron beam moving with uniform velocity is gradually diverging. When it is accelerated to a very high velocity, it again starts converging. Why?

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235. A loosely wound helix made of stiff metal wire is mounted vertically with the lower end just touching the mercury in a dish. When the current from a batter is started in the metal wire through the mercury, the wire executes oscillatory motion with the lower end jumping out of and into the mercury. Explain.

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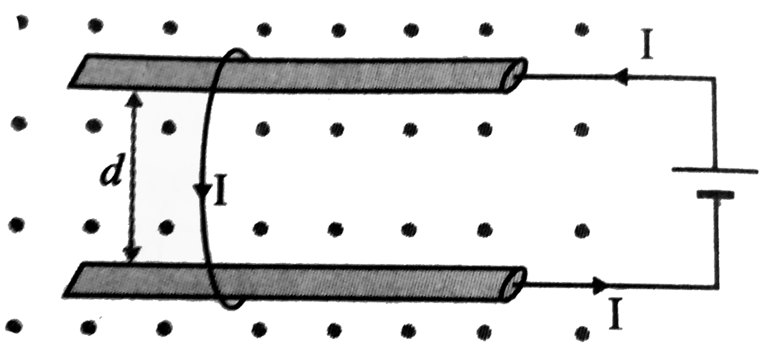
236. Why should a solenoid tend to contract when a current passes through it?

Watch Video Solution

237. A metal wire of mass m slides without friction on two horizontal rails spaced distance d-apart as shown in figure. The rails are situated in a uniform magnetic field B, directed vertically upwards, and a battery is sending a current I through them. Find the velocity of the wire as a function of time, assuming it to be at rest initially.



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238. Explain why earth's magnetic field does not affect the working of a moving coil galvanometer?

Watch Video Solution

239. A current carrying circular loop lies on a smooth horizontal plane. Can a uniform magnetic field be set up in such a manner that the loop turns around itself (i.e., turns about the vertical axis).

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240. A current carrying circular loop is located in a uniform external magnetic field. If the loop if free to turn, what is its orientation of stable equilibrium? Show that in this orientation, the flux of the total field (external field + field produced by the loop) is maximum.

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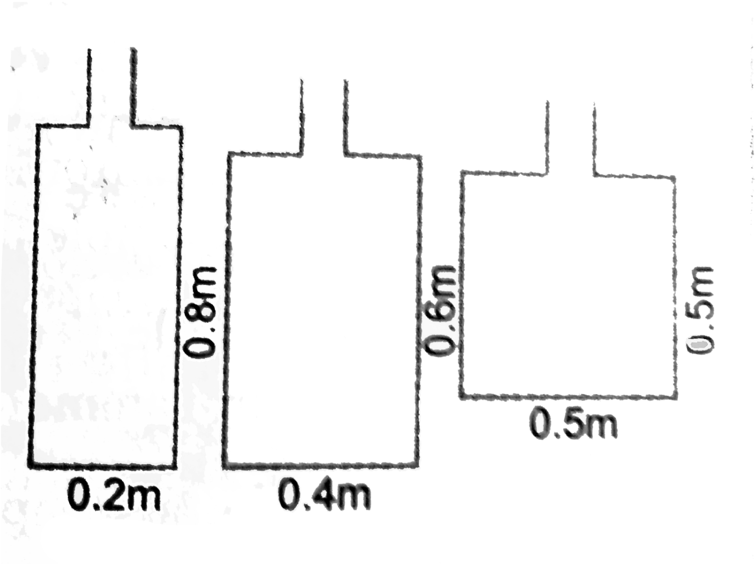
241. Three wires each of length $2 \cdot 0m$ are bent into different rectangular loops and then suspended in a magnetic field, figure. If the current in each of them be the same, which loop shall be acted upon by largest torque? If any of the wires be bent into circular loop, then?



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242. A length L of a wire carries a current I. Prove that if the wise is formed into a circular loop, the maximum torque in a given magnetic field will be developed if the coil has one turn only. Find the value of the maximum torque acting on the circular coil.

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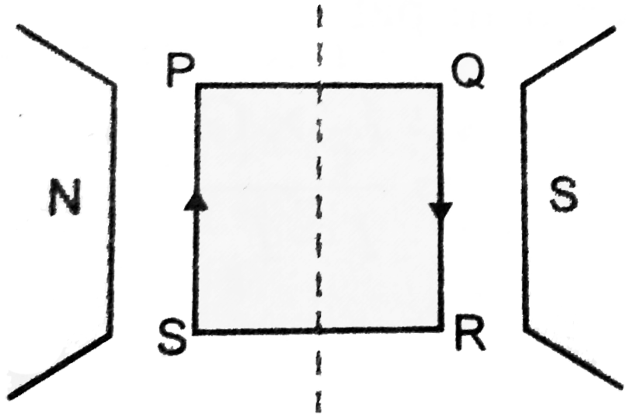
243. A rectangular current carrying loop PQRS is kept in a uniform magnetic field as shown in the figure.



(a) What is the direction of magnetic moment of the current loop?

(b) When is the torque acting on the loop

(i) maximum, (ii) zero?

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244. While convertying galvanometer into an ammeter, how does the parallel low resistance (shunt) bring the required changes in the galvanometer?

Watch Video Solution

245. A loop of irregular shape carrying current is located in an external magnetic field. If the wire is flexible, why does it change to a circular shape?

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246. A galvanometer gives full scale deflection with current I_g. Can it be converted into an ammeter of range $I < I_g$?

Watch Video Solution

247. Can we increase or decrease the range of a given ammeter?

Watch Video Solution

248. Write two reasons, why a galvanometer cannot be used as such to measure current in a given circuit.

Watch Video Solution

249. When an ammeter is put in series of a circuit, does it record slightly less or more than the actual current in the circuit ? Explain.

Watch Video Solution

250. When a voltmeter is put across a part of the circuit, does it record slightly less or more than the actual voltage across that part? Explain.

Watch Video Solution

251. Why should the resistance of an ideal voltmeter be infinite and of ideal ammeter be zero?

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252. Can we decrease or increase the range of the given voltmeter?

Watch Video Solution

253. Why is ammeter connected in series and voltmeter in parallel in the circuit?

Watch Video Solution

254. Which one has lowest resistance, ammeter, voltmeter and galvanometer? Explain.

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255. By mistake, a voltmeter is connected in series and an ammeter is connected in parallel, with a resistance in an electrical circuit. What will happen to the instruments?

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256. A galvanometer of resistance G can be converted into a voltmeter of range θ - V volts by connecting a resistance R in series with it. How much resistance will be required to change its range from 0 to $V/2$?

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257. A coil of N turns and radius R carries a current I. It is unwound and rewound to make another coil of radius $R/2$, current remaining the same. Calculate the ratio of magnetic moments of the new coil and the original coil.

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258. Why is a current loop considered a magnetic dipole?

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259. Does the length of an iron bar change when it is magnetized?

Watch Video Solution

260. What is meant by magnetic screening or shielding?

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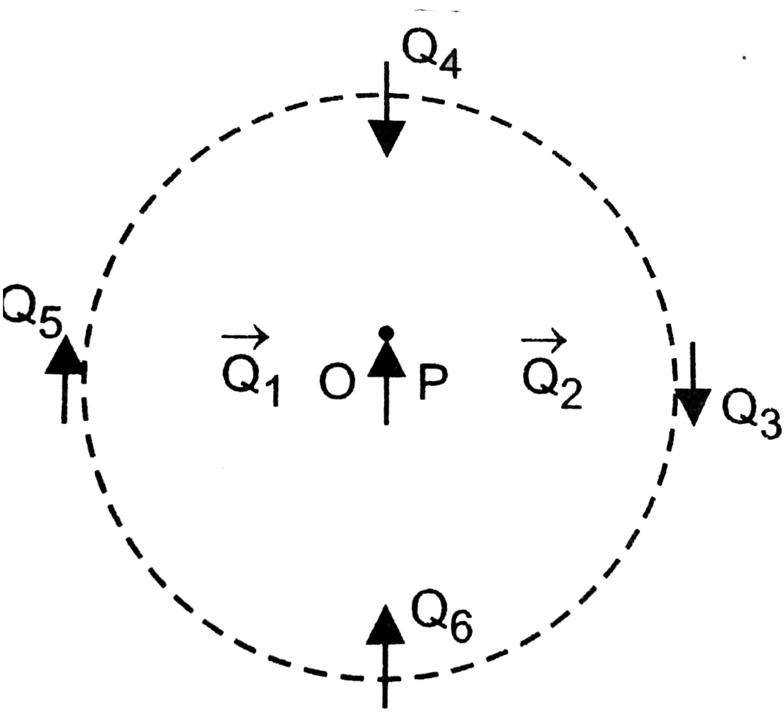
261. Figure shows a small magnetized needle P placed at a point O. The arrow shows the direction of magnetic moment. The other arrows show different positions (and orientations of the magnetic moment) of another identical magnetized needle Q.

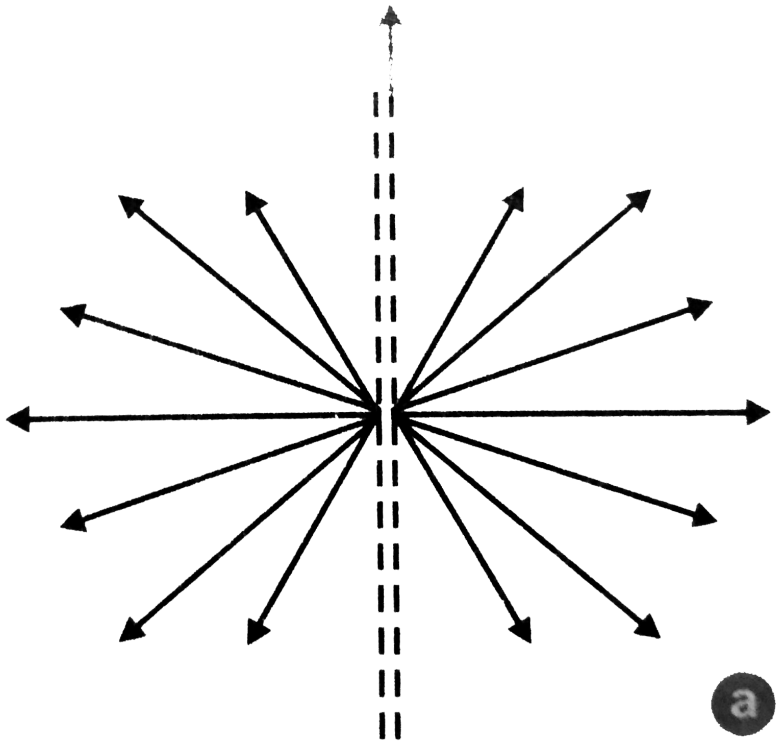


(a) In which configuration is the system not in equilibrium?

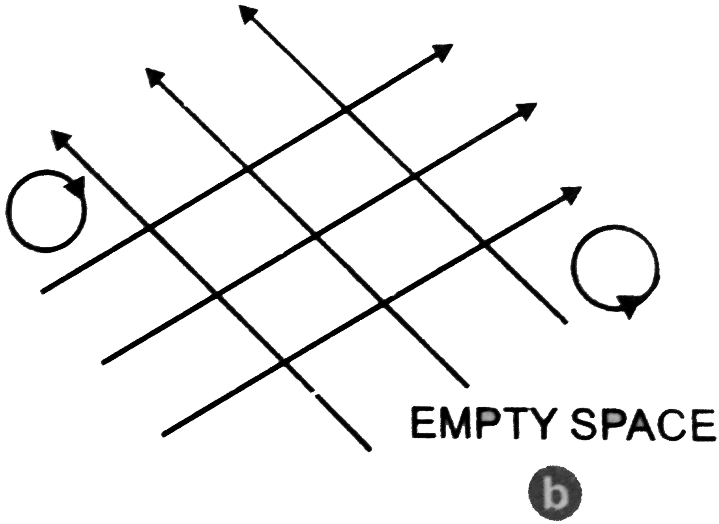
(b) In which configuration is the system in (i) stable and (ii) unstable equilibrium?

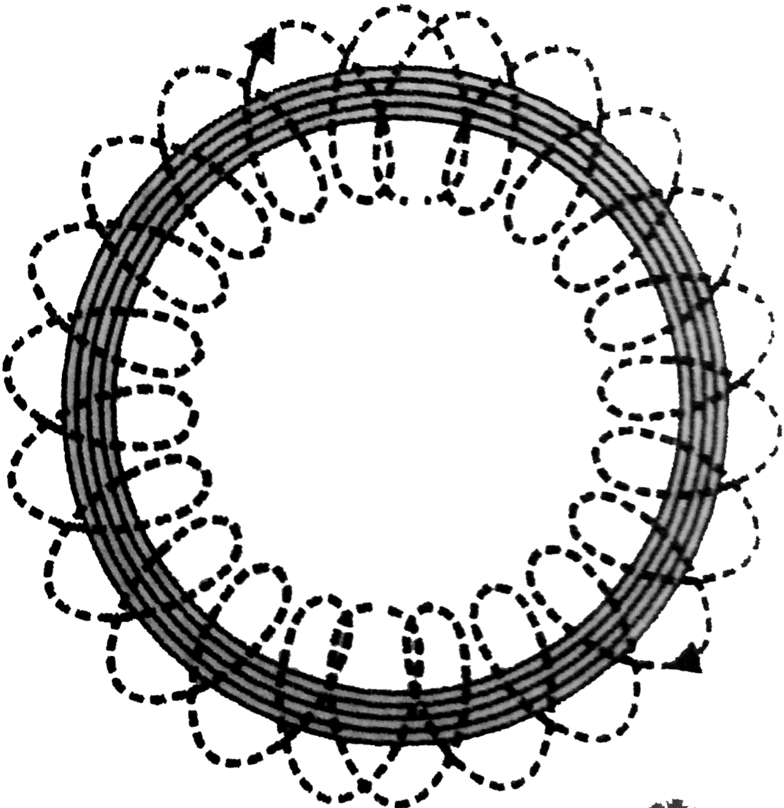
(c) Which configuration corresponds to the lowest potential energy among all the configurations shown?

262. Many of the figure.



show magnetic field lines wrongly (thick lines in the figs). Point out what is wrong with them. Some of them may describe electrostatic field lines correctly. Point out which ones. Remember we are talking of only static electric or magnetic field.


EMPTY SPACE
b



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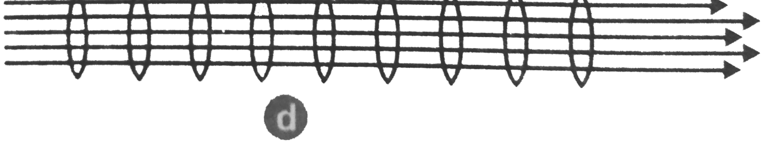

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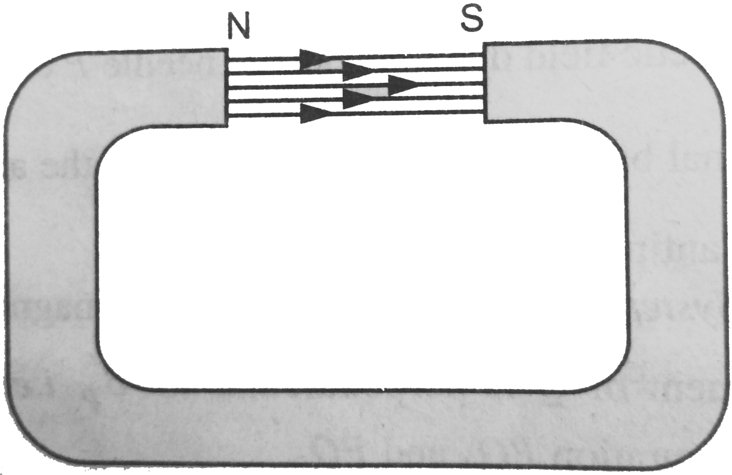
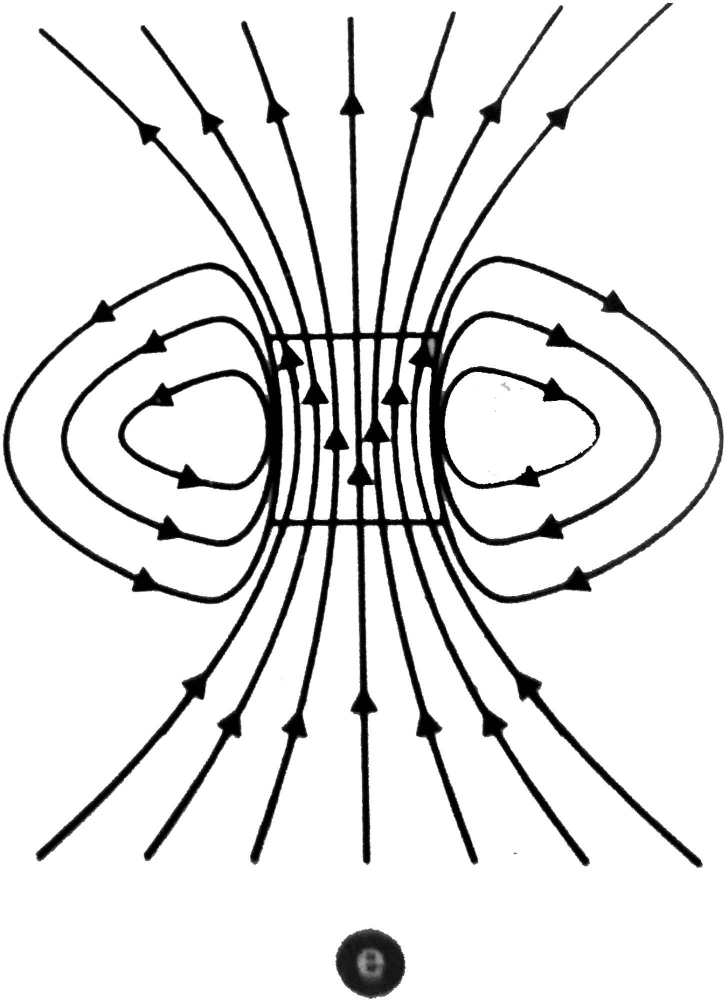
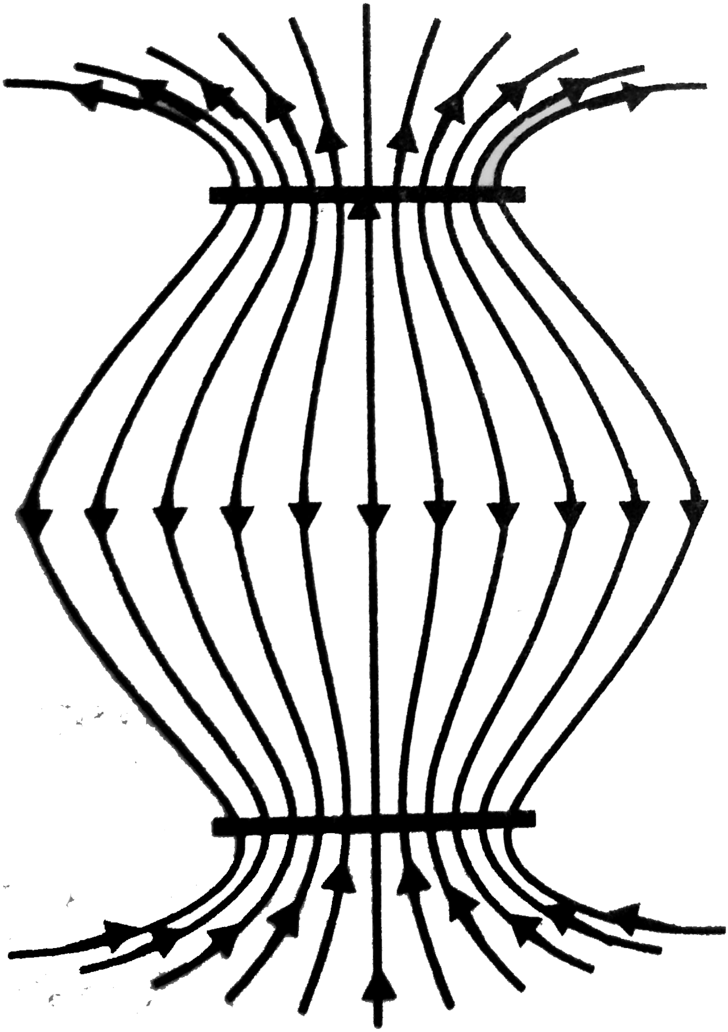


g





263. (a) Magnetic field lines show the directions (at every point) which a small magnetised needle takes up (at that point). Do the magnetic field lines also represent the lines of force of a moving charged particle at every point?

(b) Magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid. Why?

(c) If magnetic monopoles existed, how would Gauss's law of magnetism be modified?

(d) Does a bar magnet exert a torque on itself due to its own field? Does one element of a current carrying wire exert a force on another element of the same wire?

(e) Magnetic field arises due to charges in motion. Can a system have magnetic moment even though its net charge is zero?

(f) Magnetic force is always normal to the velocity of a charge and therefore does no work. An iron nail held near a magnet, when released, increases its kinetic energy as it moves to cling to the magnet. What agency is responsible for this increase in kinetic energy if not the magnetic field?

Watch Video Solution

264. What is meant by magnetic field? How is it produced?

Watch Video Solution

265. A bar magnet is placed in a uniform magnetic field with its magnetic moment making an angle θ with the field. Write expressions for torque on the bar magnet and potential energy of magnet in this orientation. When it this energy minimum?

Watch Video Solution

266. A bar magnet of magnetic moment M is aligned parallel to the direction of a uniform magnetic field B. Calculate work done to align the magnetic moment (i) opposite to the field (ii) normal to field direction?

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267. Using the relation for potential energy of a current carrying planar loop in a uniform magnetic field, obtain expression for work done in moving the planar loop from its unstable equilibrium position to the stable position.

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268. (a) What happens if a bar magnet is cut into two pieces (i) transverse to its length (ii) along its length?

(b) What happens if an iron bar magnet is melted? Does it retain its magnetism?

(c) A magnetized needle in a uniform magnetic field experiences a torque but no net force. However, an iron nail near a bar magnet experiences a force of attraction in addition to a torque, explain.

(d) Must every magnetic field configuration have a north pole and a south pole? What about the field due to a toroid?

(e) Can you think of magnetic field configuration with three poles?

(f) Two identical looking iron bars A and B are given, one of which is definitely known to be magnetized. How would one ascertain whether or not both are magnetized? If only one is magnetized how does one ascertain which one? Use nothing else but the bars A and B.

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269. The angle of dip at a location in southern India is about 18°. Would you expect a greater or lesser dip angle in Britain?

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270. How many neutral points on a horizontal board are there when a magnet is held vertically on the board?

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271. At a neutral point, does a compass needle point along N-S direction?

Watch Video Solution

272. A small compass needle of magnetic moment M is free to turn about an axis perpendicular to the direction of uniform magnetic field B. The moment of inertia of the needle about the axis is I. The needle is slightly displaced from its stable position and then released. Prove that it executes simple harmonic motion. Hence deduce the expression for its time period.

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273. A compass needle, pivoted about the horizontal axis and forced to move in the magnetic meridian is observed to point along (i) vertical direction at place A, (ii) horizontal direction at place B. What are the angles of dip at the two places?

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274. A compass box and a dip circle were taken to magnetic north pole of earth. What would one observe with regard to the direction of their needles and why?

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275. Why are 2, 50 and 500 turns provided in the coil of tangent galvanometer?

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276. What is tangent law in magnetism?

Watch Video Solution

277. Mention two charateristic properties of the material suitable for making core of a transformer.

Watch Video Solution

278. Give two characteristics of a material used for making permanent magnets.

Watch Video Solution

279. The susceptibility of a magnetic material is $1 \cdot 9 \times 10^{-5}$. What type of material does it represent?

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280. The susceptibility of a magnetic material is $-4 \cdot 2 \times 10^{-6}$. What type of material does it represent?

Watch Video Solution

281. The relative magnetic permeability of a magnetic material is 800. Identify the type of material.

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282. Two substances A and B have relative permeabilities slightly greater and less than unity respectively. What is their magnetic nature?

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283. Susceptibility of iron is more than that of copper. What does this statement imply?

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284. What happens when a diamagnetic substance is placed in a varying magnetic field?

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285. How does the intensity of magnetization of a paramagnetic material vary with increasing applied magnetic field?

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286. Why do magnetic lines of force prefer to pass through ferromagnetic materials?

Watch Video Solution

287. What is the basic use of hysteresis curve?

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288. An iron bar magneti is heated to $1000^\circ C$ and then cooled in a magnetic field free space. Will it retain magnetism?

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289. The north pole of a magnet is brought near a stationary negatively charged conductor. Will the pole experience any force?

Watch Video Solution

290. An electron moving with a velocity of $10^7 ms^{-1}$ enters a uniform magnetic field of $1T$, along a direction parallel to the field. What would be its trajectory?

Watch Video Solution

291. Explain, how moving charge is a source of magnetic field.

Watch Video Solution

292. What are the dimensions of $\mu_0 / 4\pi$?

Watch Video Solution

293. Name the physical quantity whose unit is tesla. Hence define a tesla.

Watch Video Solution

294. State Biot-Savart's law and express this law in the vector form.

Watch Video Solution

295. An electron beam projected along + X-axis, experience a force due to a magnetic field along the + Y-axis. What is the direction of the magnetic field?

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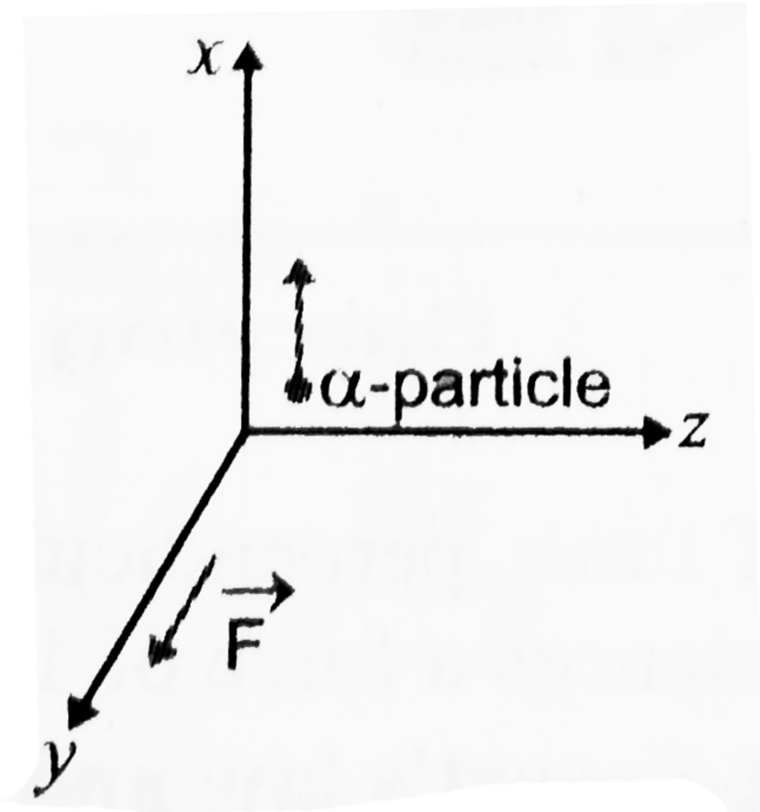
296. If a particle of charge q is moving with velocity v along the y-axis and the magnetic field B is acting along the z-axis, use the expression $\vec{F} = q\left(\vec{v} \times \vec{B}\right)$ to find the direction of the force $\vec{F}$ acting on it.

Watch Video Solution

297. A beam of α particles projected along + x-axis, experiences a force due to a magnetic field along the +y-axis figure. What is the direction of magnetic field.



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298. State the rule that is used to find the direction of magnetic field acting at a point near a current carrying straight conductor.

Watch Video Solution

299. Where is the magnetic field of a current element (i) minimum and (ii) maximum?

Watch Video Solution

300. What is the nature of the magnetic field associated with the current in a straight conductor?

Watch Video Solution

301. How does a current loop behave like a bar magnet?

Watch Video Solution

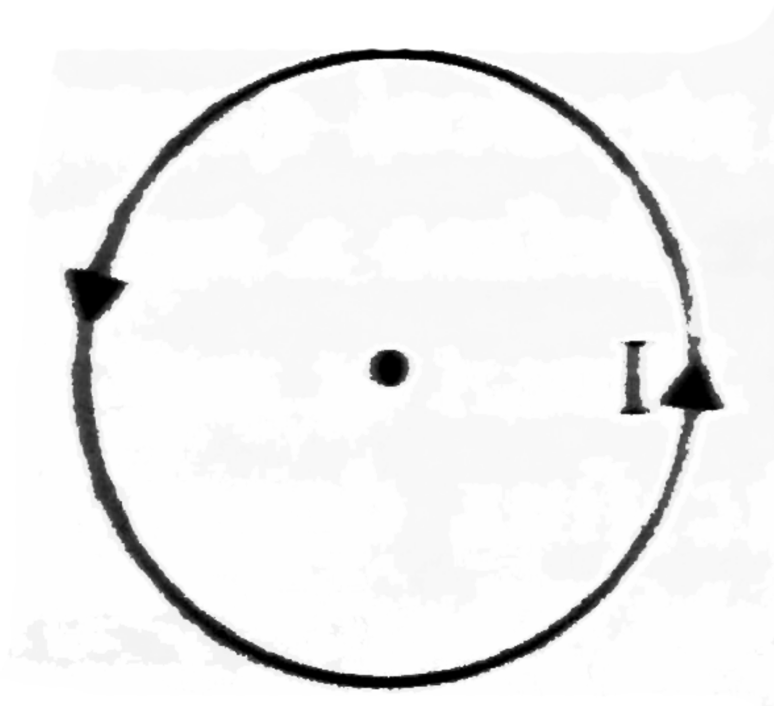
302. Where is the magnetic field due to current through circular loop is (i) uniform and (ii) non-uniform?

Watch Video Solution

303. How will the magnetic field induction at the centre of a circular coil carrying current change, if the current through the coil is doubled and the radius of the coil is halved?

Watch Video Solution

304. In figure is shown a circular loop carrying current I. Show the direction of the magnetic field with the help of lines of force.



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305. A current is set up in a long copper pipe. Is there a magnetic field (a) inside (b) outside the pipe?

Watch Video Solution

306. Can the path of integration around which we apply Ampere's law pass through a conductor?

Watch Video Solution

307. Compare Gauss's law and Ampere's law.

Watch Video Solution

308. Magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid. Why?

Watch Video Solution

309. How is the magnetic field inside a given solenoid made strong?

Watch Video Solution

310. What is the difference between solenoid and toroid?

Watch Video Solution

311. In a solenoid carrying current, where is the magnetic field (i) maximum (ii) minimum and (iii) half of the maximum value?

Watch Video Solution

312. What is the value of absolute permeability of free space? Give its units.

Watch Video Solution

313. Is the source of magnetic field analogue to the source of electric current.

Watch Video Solution

314. What is the path of a charged particle moving in a uniform electrostatic field with initial velocity (i) parallel to the field? (ii) perpendicular to the field ? (iii) at some angle with the direction of electric field?

Watch Video Solution

315. What is the path of a charged particle moving in a uniform magnetic field with initial velocity (i) parallel to the field? (ii) perpendicular to the field? (iii) at some angle with the direction of magnetic field.

Watch Video Solution

Watch Video Solution

316. What is the magnitude and direction of force on an electron moving along the direction of the magnetic field.

Watch Video Solution

317. When a charged particle moving with a velocity $\vec{v}$ is subjected to a magnetic field $\vec{B}$, the force acting on it is non zero. Would the particle gain any energy?

Watch Video Solution

318. Show that the kinetic energy of the particle moving in a magnetic field remains constant

Watch Video Solution

319. An electron is moving vertically downwards. If it passes through a magnetic field which is directed from south to north in a horizontal plane, then in which direction the electron would be deflected?

Watch Video Solution

320. A proton beam is moving horizontally form south to north in a tube. The vertical component of earth's magnetic field is directed towards. In which direction will the beam be deflected?

Watch Video Solution

321. A charged particle moving in a uniform magnetic field penetrates a layer of lead and thereby loses one half of its kinetic energy. How does the time period of revolution of particle change.

Watch Video Solution

322. When a charged particle moves in a magnetic field, does its kinetic energy always remain constant? Explain.

Watch Video Solution

323. Establish analytically that the gain in kinetic energy of the charged particle moving in a magnetic field is zero.

Watch Video Solution

324. A charged particle moving in a uniform magnetic field penetrates a layer of lead and there by loses one-half of its kinetic energy. How does the radius of curvature of its path change?

Watch Video Solution

325. State the principle of working of a cyclotron.

Watch Video Solution

326. An elelctron moves with velocity $\vec{v} = a\hat{k}$ in a magnetic field, $\vec{B} = b\hat{i} + c\hat{j}$. Find the magnetic force on the electron.

Watch Video Solution

327. A uniform magnetic field and a uniform electric field are produced, pointing in the same direction. An electron is projected with its velocity pointed in the same direction. What will be the effect on electron?

Watch Video Solution

328. What is meant by cyclotron frequency?

Watch Video Solution

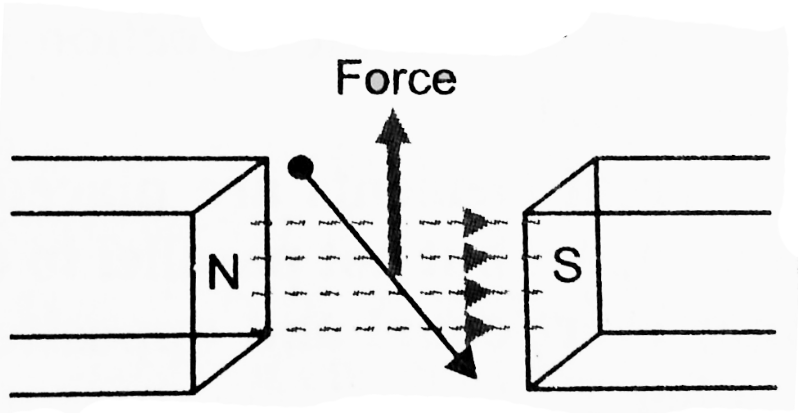
329. Looking downward, an electron appears moving anticlock-wise on a horizontal circle under a magnetic field. What is the direction of the magnetic field?

Watch Video Solution

330. Which physical quantity has the unit Wb/m^2? It is a scalar or a vector quantity?

Watch Video Solution

331. A charged particle enters into a uniform magnetic field and experiences upward force as indicated in figure. What is the charge sign on the particle?



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332. Write expression for the force between two short parallel wires carrying the currents when they are:

(a) much separated (b) very close

Watch Video Solution

333. What type of force is acting between two parallel wires carrying current in the same direction? What happens if one of the current is reversed?

Watch Video Solution

334. What is the force that a conductor $d\vec{l}$ carrying a current I experiences, when placed in a magnetic field $\vec{B}$, when its length is making an angle of 30° with the direction of field?

Watch Video Solution

335. If the distance between two parallel current carrying wires is doubled, what is the force between them?

Watch Video Solution

336. In which orientation is the force experienced by a current-carrying conductor placed in a magnetic field (i) minimum (ii) maximum?

Watch Video Solution

337. Two current elements are placed a certain distance apart but not parallel to each other. Do they exert equal and opposite forces on each other?

Watch Video Solution

338. The force exerting between the two parallel current carrying conductors if F. If the current in each conductor is doubled, what is the value of force acting between them?

Watch Video Solution

339. Quite often, connecting wires carrying currents in opposite directions are twisted together in using electrical appliances. Explain how it avoids unwanted magnetic fields.

Watch Video Solution

340. What is the ratio of electric and magnetic forces between two moving charges?

Watch Video Solution

Watch Video Solution

341. A horizontal wire placed perpendicular to a magnetic field carries a current from left to right. The magnetic field is horizontal, directed towards you. What is the direction of magnetic force on the wire?

Watch Video Solution

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

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343. A current carrying wire does not tend to rotate in a magnetic field. What do you conclude from this?

Watch Video Solution

344. What is the magnitude of torque which acts on a coil carrying current placed in a uniform radial magnetic field?

Watch Video Solution

345. Two wires of equal lengths are bent in the form of two loops. One of the loops is square shaped whereas the other loop is circular. These are suspended in a uniform magnetic field and the same current is passed through them. Which loop will experience greater torque? Give reasons.

Watch Video Solution

346. On what interaction is the principle of galvanometer based?

Watch Video Solution

347. What is the value of net force acting on a current carrying (i) rectangular coil and (ii) circular coil of same area placed in a uniform magnetic field? What will be the torque acting in each case?

Watch Video Solution

348. State the principle of moving coil galvanometer.

Watch Video Solution

349. What is a dead beat galvanometer?

Watch Video Solution

350. Why is the coil wrapped on a conducting frame in a galvanometer?

Watch Video Solution

351. What is the function of soft iron cylinder between the poles of a galvanmeter?

Watch Video Solution

352. Why are pole pieces of galvanometer made concave?

Watch Video Solution

353. What is the function of the radial magnetic field in the moving coil galvanometer?

Watch Video Solution

354. Define the current sensitivity of a moving coil galvanometer and state its SI unit?

Watch Video Solution

355. Write two factors by which the current sensitivity of a moving coil galvanometer can be increased?

Watch Video Solution

356. Can a galvanometer as such be used for measuring the current? Explain.

Watch Video Solution

357. What is the resistance of ideal ammeter and ideal voltmeter?

Watch Video Solution

358. What is meant by figure of merit of a galvanometer?

Watch Video Solution

359. Which has greater resistance

(a) milliammeter or ammeter?

(b) milli voltmeter or voltmeter?

Watch Video Solution

360. Why should an ammeter have a high current carrying capacity?

Watch Video Solution

361. Why should a voltmeter have a low current carrying capacity?

Watch Video Solution

362. A voltmeter, an ammeter and a resistance are connected in series with a lead accumulator. The voltmeter gives some deflection but the deflection of ammeter is almost zero. Explain why?

Watch Video Solution

363. A galvanomter of resistance 50Ω is shunted by a resistance of 5Ω. What fraction of the main current passes through the galvanometer? Through the shunt?

364. A current of $10^{-7}A$ produces 50 division deflection in a galvanometer. Find its figure of merit.

365. Can moving coil galvanometer be used to detect an a.c. in a circuit? Give reason.

366. What are the SI units of pole strength and magnetic moment?

Watch Video Solution

367. What is the direction of magnetic dipole moment?

Watch Video Solution

368. Write the formula of magnetic moment of a current loop.

Watch Video Solution

369. A magnet of length $2l$ and pole strength m is divided in two equal parts along its length. What is magnetic moment of each part?

Watch Video Solution

370. Distinguish between a magnetic dipole and an electric dipole.

Watch Video Solution

371. Name some magnetic and non-magnetic substances.

Watch Video Solution

372. What is a magnetic dipole?

Watch Video Solution

373. Can we have a magnet with a single pole?

Watch Video Solution

374. Are the two poles of a magnet equally strong?

Watch Video Solution

375. What is sure test of magnetism?

Watch Video Solution

376. Magnetic lines of force are endless. Comment.

Watch Video Solution

377. A magnet of length $2l$ and pole strength m is equally divided in two parts, perpendicular to its length. What is the magnetic moment of each?

Watch Video Solution

378. What is the significance of Gauss's Law in magnetism?

Watch Video Solution

379. Give two examples of magnetic dipole.

Watch Video Solution

380. On what factors does the pole strength of a magnet depend?

Watch Video Solution

381. What is the basic difference between magnetic and electric lines of force?

Watch Video Solution

382. Give one important point of distinction between magnetism and electricity?

Watch Video Solution

383. What is meant by strength of magnetic field at any point?

Watch Video Solution

384. Write an expression for magnetic field intensity at any point an axial line of a bar magnet.

Watch Video Solution

385. On equatorial line of bar magnet, what is the formula for magnetic field strength?

Watch Video Solution

386. A magnetic dipole is situated in the direction of a magnetic field. What is its potential energy? If it is rotated by 180°, then what amount of work will be done?

Watch Video Solution

387. What is the strength of earth's magnetic field at the surface of earth?

Watch Video Solution

388. What is the potential energy of a dipole when it is perpendicular to a magnetic field?

Watch Video Solution

389. What is the torque acting on a magnet of magnetic moment M held at an angel θ with the direction of magnetic field B?

Watch Video Solution

390. What does the torque do?

Watch Video Solution

391. What is the expression for potential energy of a dipole of moment M held at an angle θ with a magnetic field B?

Watch Video Solution

392. When is potential energy of a magnetic dipole minimum?

Watch Video Solution

393. Where is the vertical component of earth's magnetic field zero?

Watch Video Solution

394. A magnetic needle placed on a piece of cork is floating on the calm surface of a lake in the northern hemisphere. Would the magnetic needle alongwith the cork move towards north?

Watch Video Solution

395. What is the approximate distance upto which earth's magnetic field extends?

Watch Video Solution

396. What are isogonic, isoclinic and isodynamic lines?

Watch Video Solution

397. What is the maximum value of angle of dip?

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398. What is the angle of dip at a place where horizontal and vertical components of earth's field are equal?

Watch Video Solution

399. A compass needle, free to turn in a vertical plane orients itself with its axis vertical at a certain place on the earth. Find out the values of (i) Horizontal component of earth's magnetic field and (ii) angle of dip at that place.

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400. The angles of dip at two places are respectively 0° and 90°. Where are these values on earth?

Watch Video Solution

401. In the northern hemisphere, do magnetic lines of force due to earth's field point towards or away from earth?

Watch Video Solution

402. Name the elements or parameters of earth's magnetic field.

Watch Video Solution

403. What is magnetic inclination at a place?

Watch Video Solution

404. What is a reduction factor of tangent galvanometer and its unit of measurement?

Watch Video Solution

405. Before using tangent galvanometer for the measurement of current, why is the plane of coil of tangent galvanometer set in the magnetic meridian?

Watch Video Solution

406. What is the order of magnetic moment of an atom?

Watch Video Solution

407. What are the SI units of magnetic field induction or magnetic flux density?

Watch Video Solution

408. What are the SI units of magnetising force or magnetising intesity?

Watch Video Solution

409. Name the cgs unit of magnetising intensity. How is it related to SI unit of intensity.

Watch Video Solution

410. What is relative magnetic permeability of superconductors?

Watch Video Solution

411. What is magnetic susceptibility of super conductors.

Watch Video Solution

412. What is Meissner effect?

Watch Video Solution

413. What is the SI unit of magnetic field?

Watch Video Solution

414. Name the SI unit of intensity of magnetisation.

Watch Video Solution

415. What are units of magnetic permeability?

Watch Video Solution

416. Write the relation between relative permeability and susceptibility.

Watch Video Solution

417. How does the magnetic susceptibility of a paramagnetic material change with temperature?

Watch Video Solution

418. What are SI units of magnetic susceptibility?

Watch Video Solution

419. Which of the following substances are diamagnetic?

Copper, Aluminium, Sodium, Bismuth

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420. Which of the following substances are paramagnetic?

Al, Bi, Cu, Ca, Pb, Ni.

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421. The permeability of Bismuth is $0 \cdot 9983$. To which class of magnetic material Bi belongs.

Watch Video Solution

422. What is curie point?

Watch Video Solution

423. What is the basic difference between the atom/molecule of a diamagnetic and paramagnetic material?

Watch Video Solution

424. Why are electromagnets made of soft iron?

Watch Video Solution

425. What is the net magnetic moment of an atom of a diamagnetic material?

Watch Video Solution

426. Magnetization and demagnetization of soft iron is easier/more difficult as compared steel. Why?

Watch Video Solution

427. Classify the following into dia and paramagnetic substances: aluminium, copper, water, mercury, oxygen, hydrogen.

Watch Video Solution

428. Which materials have negative value of magnetic susceptibility?

Watch Video Solution

429. Write the names of three ferromagnetic substances.

Watch Video Solution

430. Magnetic moment of atoms of certain materials is zero. Name such materials.

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431. Name any three paramagnetic materials.

Watch Video Solution

Watch Video Solution

432. Which materials have relative magnetic permeabilitygt1?

Watch Video Solution

433. Can there be a material, which is non magnetic?

Watch Video Solution

434. Write the relation for the force $\vec{F}$ acting on a charge carrier q moving with a velocity $\vec{}$ through a magnetic field $\vec{B}$ in vector notation. Using the reltation, deduce the conditions under which this force will be (i) maximum (ii) minimum.

Watch Video Solution

435. Explain the rule with illustration, related to the direction of current through a linear conductor and magnetic field.

Watch Video Solution

436. What is magnetic flux density? Define its units and give its dimensions.

Watch Video Solution

437. In what respect does a wire carrying a current differ from a wire, which carries no current?

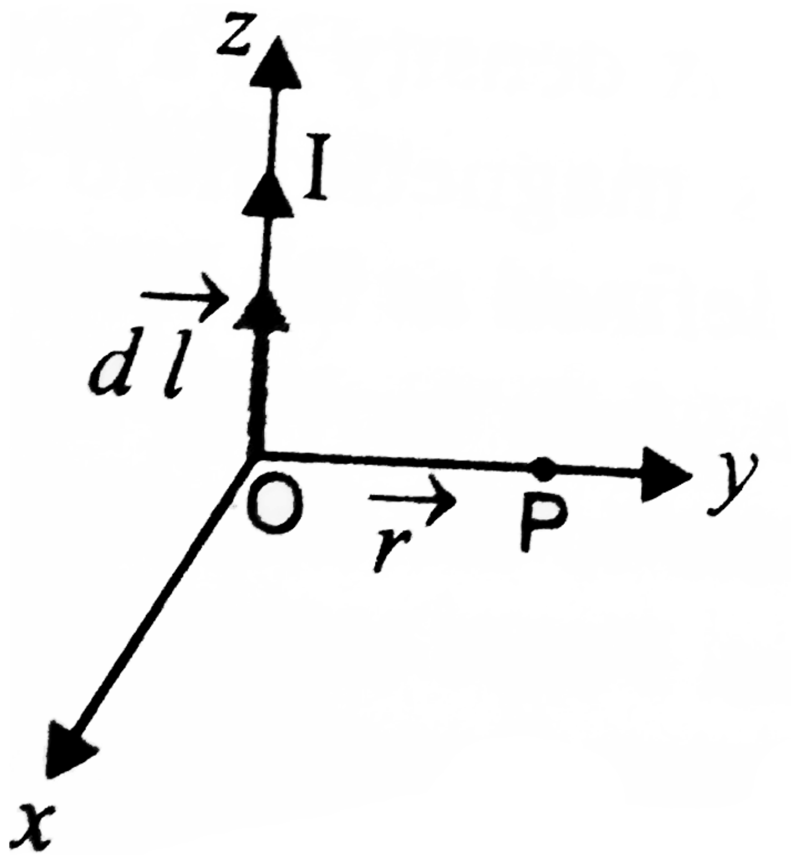
Watch Video Solution

438. A current of one ampere is passed through a straight wire of length $2 \cdot 0$ metre. Find the magnetic field at a point in air at a distance 3 metre from one end of wire but lying on the axis of the wire.

Watch Video Solution

439. State Biot Savart's law. A current I flows in a conductor placed perpendicular to the plane of paper. Indicate the direction of the magnetic field due to a small element $d\vec{l}$ at a point P at a distance

$\vec{r}$ from the element as shown in figure.



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440. Write the relation for the magnetic field induction at a point due to a linear conductor carrying current and hence deduce the relation for the magnetic field induction at a point due to a very long linear conductor carrying current.

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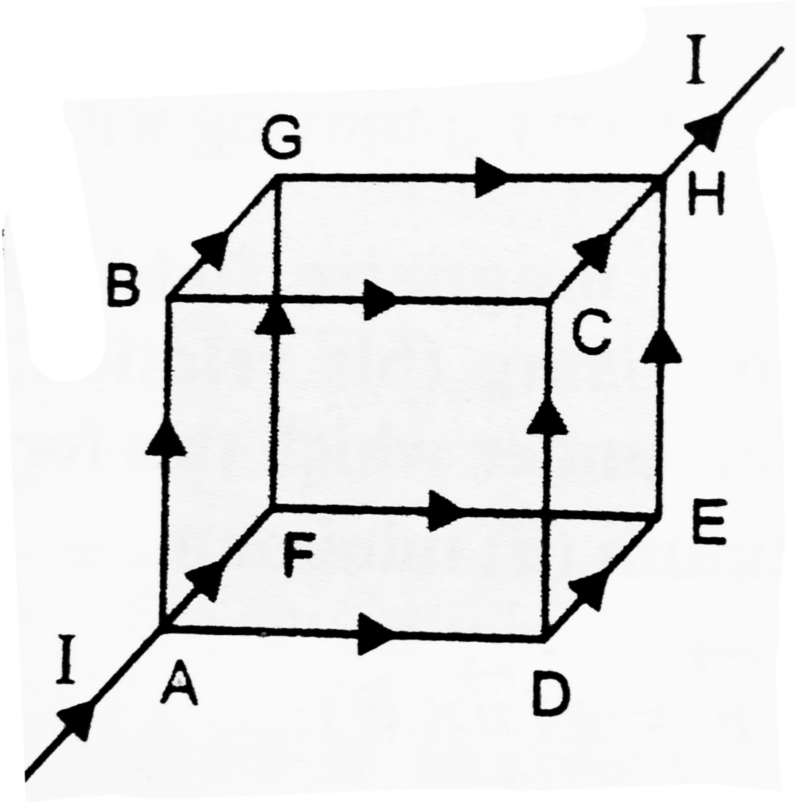
441. Figure shows a cube made from twelve uniform wires. Find the magnetic field at the centre of the cube, if a battery is connected between the points A and H.



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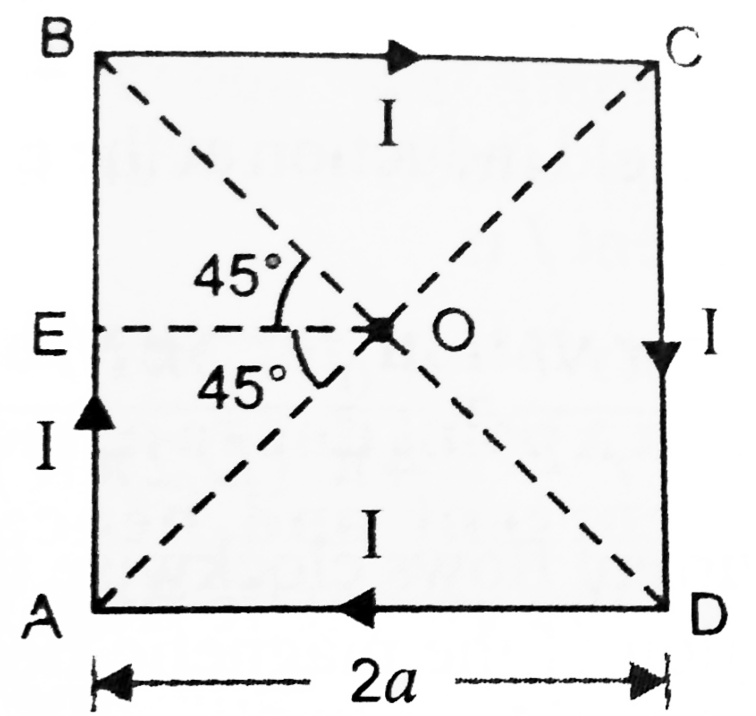
442. Find the experssion for the magnetic field at the centre O of a coil bent in the form of a square of side $2a$, carrying current I, figure.



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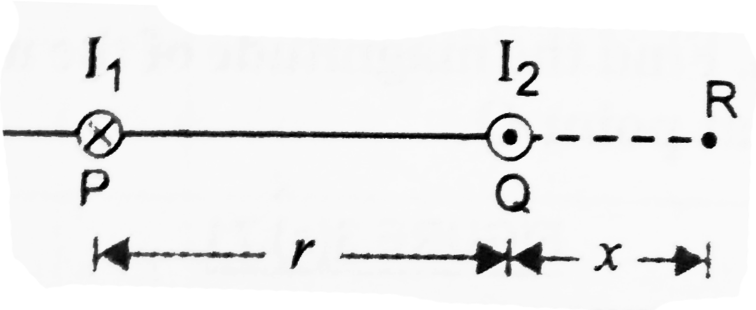
443. Two parallel wires P and Q placed distance r apart. They are carrying currents I_1 and I_2 where $I_1 > I_2$, but in opposite directions as shown in figure. Find the point on the line PQ where the resultant magnetic field is zero.



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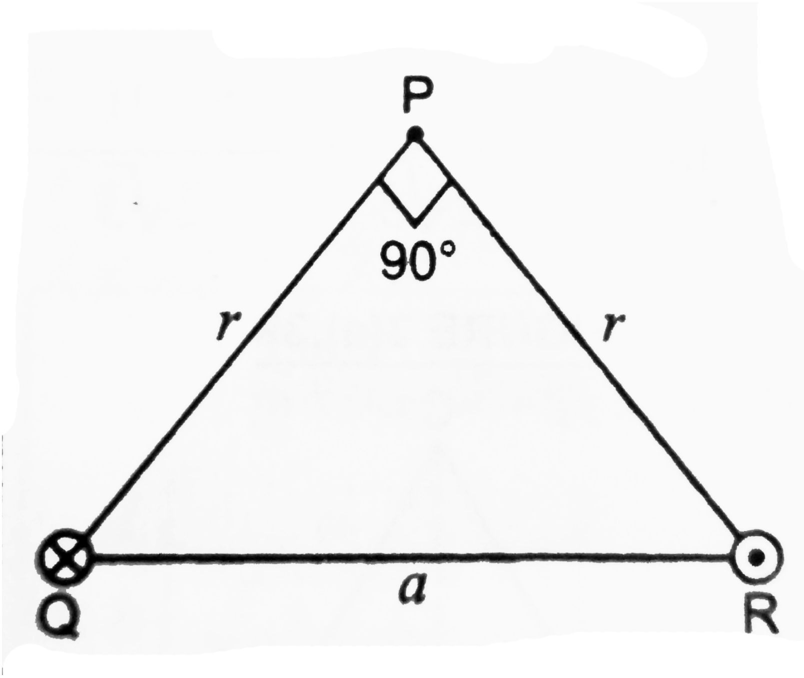
444. Figure shows a right-angled isosceles ΔPQR having its base equal to a. A current of I ampere is passing downwards along a thin straight wire cutting the plane of paper normally as shown at Q. Likewise a similar wire carries an equal current passing normally upwards at R. Find the magnitude and direction of the magnetic field induction B at P. Assume the wires to be infinity long.



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445. What is the magnetic effect of current ? Describe the nature of the magnetic field related with the current in circular coil.

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446. Plot a magnetic field due to a circular coil carrying current and explain the law used to find the direction of magnetic field at the centre of circular coil carrying current.

Watch Video Solution

447. Deduce the expression for the magnetic field induction at the centre of a circular electron orbit of radius r, and angular velocity of orbiting electron ω.

Watch Video Solution

448. What is magnetic dipole moment of a current loop? Give its direction if any.

Watch Video Solution

449. A wire of length L metre carrying a current of I ampere is bent in the form of a circle. Find its magnetic moment.

Watch Video Solution

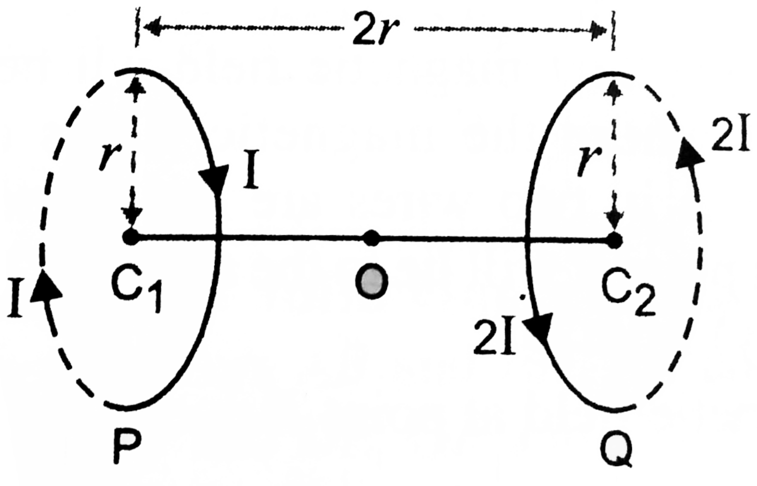
450. A wire of length L is bent around in the form of a coil having N turns of same radius . If a steady current I flows through it in a clockwise direction, find the magnitude and direction of the magnetic field produced at its centre.

Watch Video Solution

451. A circular coil of N Turns and diameter d carries a current I. It is unwound and rewound to make another coil of diameter $2d$, current I remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil.

Watch Video Solution

452. Two identical circular loops, P and Q each of radius r and carrying currents I and 2I respectively are lying in parallel planes such that they have a common axis. Their centres are distance $2r$ apart. The direction of current in both the loops is clockwise as seen from O which is equidistant from both the loops. Find the magnitude of the net magnetic field at point O.



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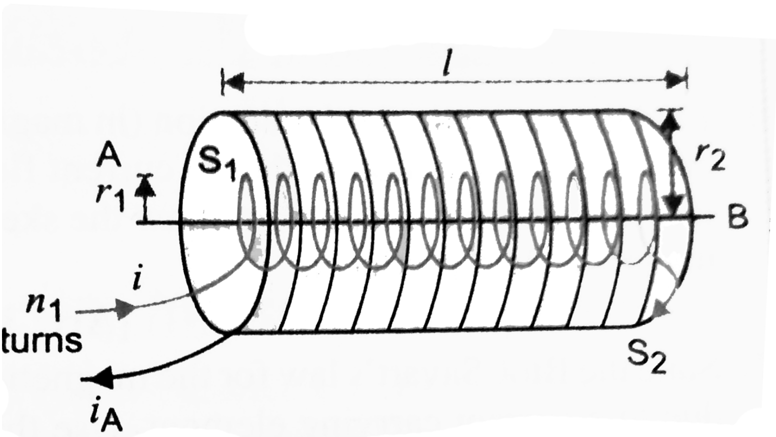
453. Show the variation of magnetic field B with perpendicular distance r from the axis of a long conducting cylinder carrying current I.

Watch Video Solution

454. Two long coaxical insulated solenoid's S_1 and S_2 of equal lengths are would one over the other as shown in figure. A steady current $'T'$ flows through the inner solenoid S_1 to the other end B, which is connected to the outer solenoid S_2 through which the same current flows in opposite direction so as to come out at end A. If n_1 and n_2 are the number of turns per unit length, find the magnitude and direction of net magnetic field at a point (i) inside on the axis and (ii) outside the combined system.



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455. Write the expression for Lorentz magnetic force on a particle of charges 'q' moving with velocity $\vec{v}$ in a magnetic field $\vec{B}$.

Watch Video Solution

456. A charged particle is moving on a circular path of radius R in a uniform magnetic field under the Lorentz force F. How much work is done by the force in one round? Is the momentum of the particle changing?

Watch Video Solution

457. Two identical charged particles moving with same speed enter a region of uniform magnetic field. If one of these enters normal to the field direction and the other enters along a direction at 30° with the field, what would be the ratio of their angular frequencies?

Watch Video Solution

458. An α-particle and a proton are moving in the plane of the paper in a region where there is a uniform magnetic field $\vec{B}$ directed normal to the plane of the paper. If the two particles have equal linear momenta, what will be the ratio of their trajectories in the field?

Watch Video Solution

459. A deutron and a proton are accelerated by the cyclotron. Can both be accelerated with the same oscillator frequency? Give reason to justify your answer.

Watch Video Solution

460. A hydrogen ion of mass m and charge q travels with a speed v along a circle of radius r in a uniform magnetic field of flux density B. Obtain the expression for the magnetic force on the ion and determine its time period.

Watch Video Solution

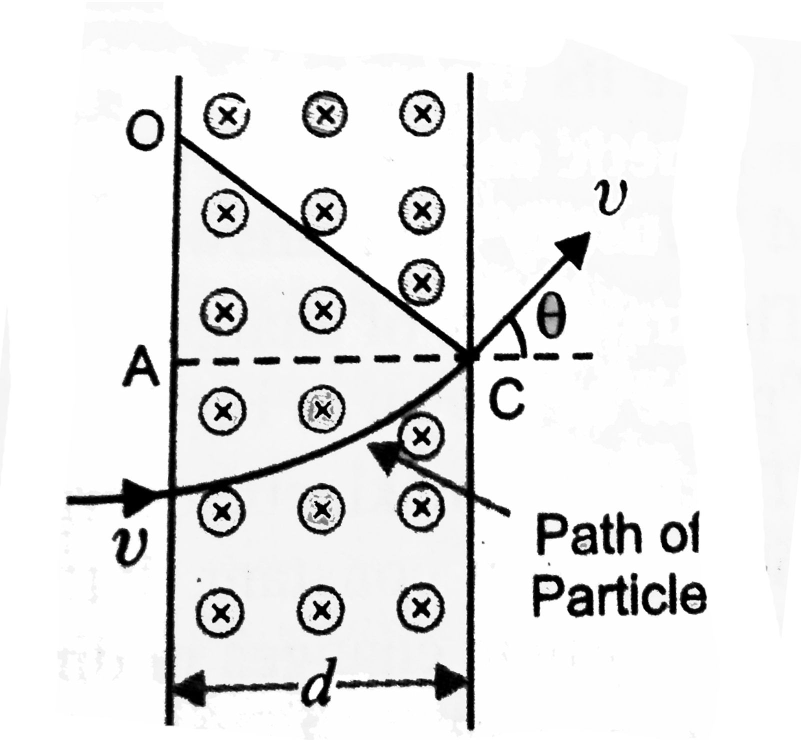
461. Show that the frequency of revolution, of a charged particle (in the X-Y plane), in a uniform magnetic field $\vec{B}\left(=B\hat{k}\right)$ is independent of its speed.

Which pratical machine makes use of this fact?

What is the frequency of the alternating electric field used in this machine?

Watch Video Solution

462. A proton and an alpha particle are projected in a perpendicular magnetic field B which exists in a region of width d, figure. Find the ratio of the sines of angles of deviation suffered by the proton and the alpha particle if before entering the magnetic field both the particles (i) have the same momentum (ii) have the same kinetic energy.



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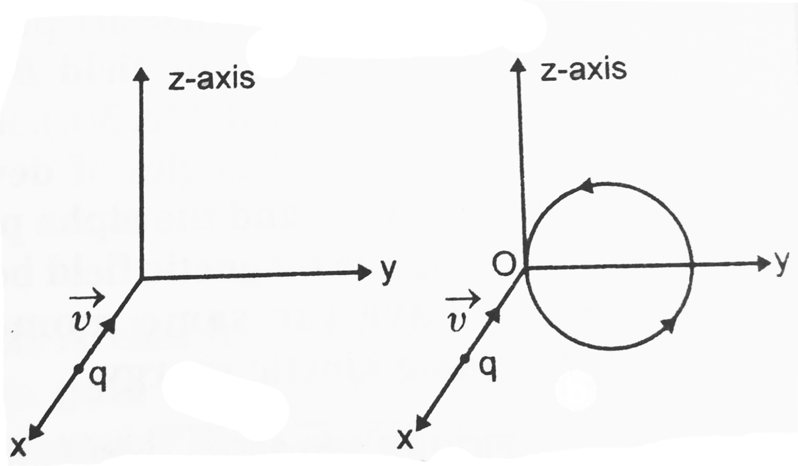
463. A charge q moving along the X-axis with a velocity $\vec{v}$ is subjected to a uniform magnetic field B acting along the Z-axis as it crosses the origin O. Figure.



(i) Trace its trajectory . (ii) Does the charge gain kinetic energy as it enters the magnetic field? Justify yous answer.

Watch Video Solution

464. A proton and a deutron having equal momenta enter in a region of uniform magnetic field at right angles to the direction of the field. Depict their trajectories in the field.

Watch Video Solution

465. A charged particle moving with a uniform velocity $\vec{v}$ enters a region where uniform electric and magnetic fields $\vec{E}$ and $\vec{B}$ are present. It passes through the region without any change in its velocity. What can we conclude about the (i) relative direction of $\vec{E}$, $\vec{V}$ and $\vec{B}$? (ii) magnetic of $\vec{E}$ and $\vec{B}$?

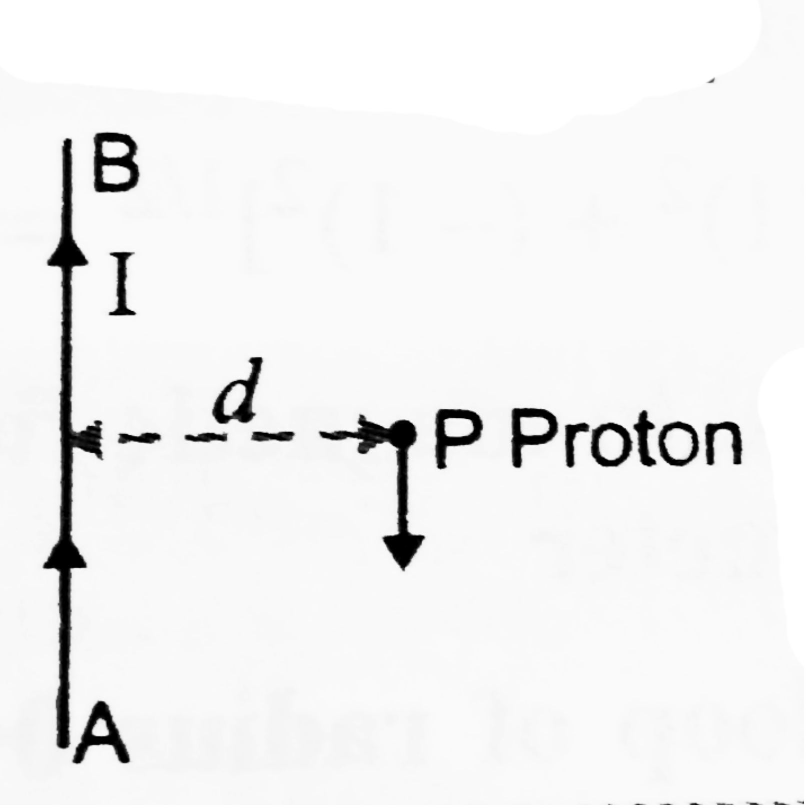
or

Find the condition under which the charged particle moving with different speeds in the presence of electric and magnetic field vectors can be used to select charged particles of a particular speeds.

Watch Video Solution

466. A long straight wire AB carries a current I. A proton P travels with a speed v, parallel to the wire, at a distance d from it in a direction opposite to the current as shown in figure. What is the

force experienced by the proton and what is its direction?



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467. A cyclotron is not suitable to accelerate electrons. Why?

Watch Video Solution

468. Explain the main functions of electric and magnetic fields in a cyclotron.

Watch Video Solution

469. What is the basic principle of working of cyclotron? Write two uses of this machine.

Watch Video Solution

470. A body is suspended from the lower end of a vertical spring. What shall be the effect on the position of the body when a current is sent through the spring? Does it depend upon the direction of current in the spring?

Watch Video Solution

471. Two long parallel wires are hanging freely. If they are connected to a battery (i) in series, (ii) in parallel, what would be the effect on their positions?

Watch Video Solution

472. What is the tendency of parallel beam of electron moving uniformly in vaccuum with (i) normal speed (ii) with high speed.

Watch Video Solution

473. A straight wire, of length L, carrying a current I, stays suspended horizontally in mid air in a region where there is a uniform magnetic field $\vec{B}$. The linear mass density of the wire is λ. Obtain the magnetic of this magnetic field.

Watch Video Solution

474. A linear conductor carrying current is placed in a magnetic field. In which situation, the force experienced by the conductor is maximum and minimum?

Watch Video Solution

475. A stream of protons is moving parallel to a stream of electrons. Will the two stream tend to come closer or move apart?

Watch Video Solution

476. A wire of length l metre carries a current I ampere along the Y-axis. A magnetic field, $\vec{B} = B_0\left(\hat{i} + \hat{j} + \hat{k}\right)$ tesla exists in space. Find the magnitude of the force on the wire.

Watch Video Solution

477. A circular loop of radius $0 \cdot 2m$ carrying a current of $1A$ is placed in a uniform magnetic field of $0 \cdot 5T$. The magnetic field is perpendicular to the plane of the loop. What is the force experienced by the loop?

Watch Video Solution

478. A small coil carrying current is held in a uniform magnetic field. How does the coil tend to orient itself relative to magnetic field?

Watch Video Solution

479. Does the torque on planar current loop in a magnetic field change when its shape is changed without changing its geometrical area.

Watch Video Solution

480. Two wires of equal lengths are bent in the form of two loops. One of the loops is square shaped whereas the other loop is circular. These are suspended in a uniform magnetic field and the same current is passed through them. Which loop will experience greater torque? Give reasons.

Watch Video Solution

481. State the underlying principle of working of a moving coil galvanometer. Write two reasons why a galvanometer can not be used as such to measure current in a given circuit.

Watch Video Solution

482. A rectangular coil of sides l and b carrying a current I is subjected to a uniform magnetic field $\vec{B}$ acting at an angle θ to its plane. Write the expression for the torque acting on it. In which orientation of the coil in the magnetic field, the torque is (i) minimum and (ii) maximum.

Watch Video Solution

483. State properties of the material of the wire used for suspension of the coil in a moving coil galvanometer.

Watch Video Solution

484. What is a radial magnetic field? How has it been achieved in moving coil galvanometer?

Watch Video Solution

485. Why is phosphor bronze alloy preferred for the suspension wire of a moving coil galvanometer?

Watch Video Solution

486. The current sensitivity of a moving coil galvanometer is $10 div/mA$ and voltage sensitivity is $20 div/V$. Find the resistance of the galvanometer.

Watch Video Solution

487. The coils, in certain galvanometers, have a fixed core made of a non-magnetic metallic material. Why does the oscillating coil come to rest so quickly in such a core?

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488. Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity. Justify this statement.

Watch Video Solution

489. Explain the action of shunt?

Watch Video Solution

490. What information would you wish to have about the galvanometer before you convert the galvanometer into an ammeter or voltmeter?

Watch Video Solution

491. Why do we not use galvanometer as an ammeter?

Watch Video Solution

492. Of the two identical galvanometers one is to be converted into an ammeter and another into a milliammeter. Which of the shunts will be of larger resistance?

Watch Video Solution

493. Why should an ammeter have a low resistance and a high current carrying capacity?

Watch Video Solution

494. Why should a voltmeter have a high resistance and a low current carrying capacity?

Watch Video Solution

495. Explain giving reasons, the basic difference in converting a galvanometer into (i) an ammeter and (ii) a votmeter.

Watch Video Solution

496. What is an ammeter? How is it used in an electric circuit? How does it differ from a voltmeter?

Watch Video Solution

497. Which one of the two, an ammeter or a milliammeter, has a higher resistance and why?

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498. Why is it that while using a moving coil galvanometer as a voltmeter, a high resistance in series is required whereas in an ammeter a shunt is used?

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499. Compare a voltmeter and an ammeter.

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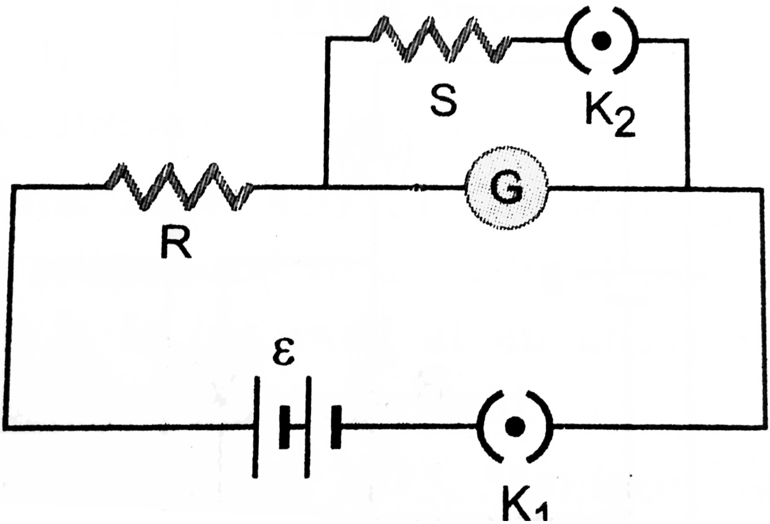
500. The current flowing in the galvanometer G when key K_2 is kept open is I. On closing the key K_2, the current in the galvanometer becomes I/n, where n is an integer. Figure



Obtain an expression for resistance G of the galvanometer in terms of R, S and n. To what form does this expression reduce when the value of R is very large as compared to S?

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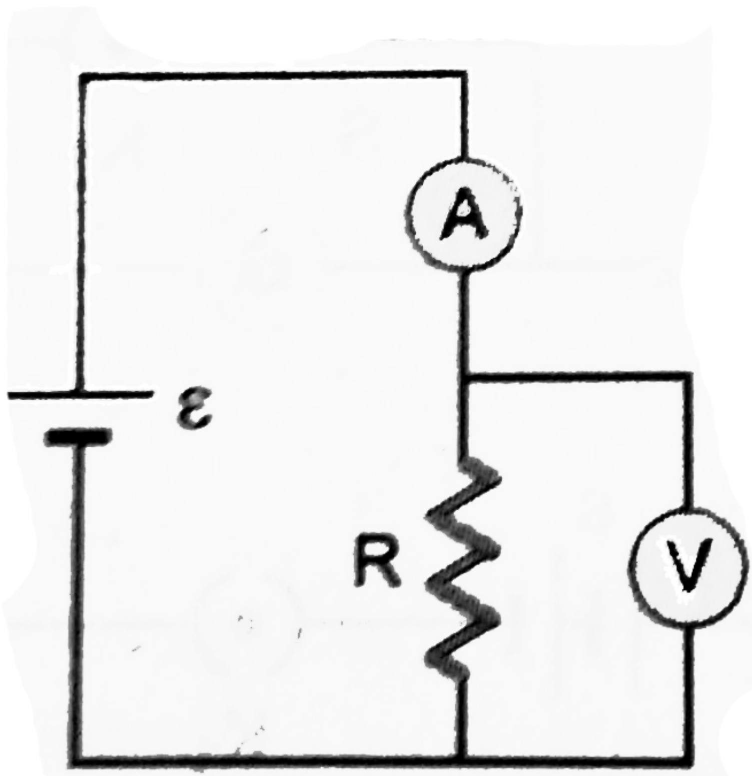
501. A voltmeter of resistance R_V and an ammeter of resistance R_A are connected in a circuit to measure a resistance R as shown in figure. The ratio of the meter readings gives an apparent resistance R'. Show that R and R' are related by the relation

$$\frac{1}{R} = \frac{1}{R'} - \frac{1}{R_V}$$



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502. How is magnetic force between two poles affected when strength of each pole is doubled and distance between them is halved?

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503. No two magnetic lines of force can intersect. Why?

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504. Can ever there be a magnet (a) with no pole (b) with two similar poles (c) with three poles?

Watch Video Solution

505. Define unit pole from Coulomb's law of magnetism.

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506. Draw magnetic field lines due to a U-shaped magnet.

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507. For a short magnetic dipole, intensity at any point an axial line is same as intensity at same distance on equatorial line. Is it true?

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508. Under what situation a magnet suspended in a uniform magnetic field will be (a) in stable equilibrium and (b) in unstable equilibrium?

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509. When will a magnet in an external magnetic field be in unstable equilibrium?

Watch Video Solution

510. What is the proof of earth's magnetism?

Watch Video Solution

511. Is there a strong magnet inside the earth responsibility for earth's magnetism? If there is a magnet, what is its inclination w.r.t. to north-south direction?

Watch Video Solution

512. At what positions, the neutral points will lie for a bar magnet when magnetic axis of magnet is lying in the magnetic meridian

(i) with N-pole of magnet pointing North

(ii) with S-pole of magnet pointing North?

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513. How does a magnetic compass behave at a neutral point?

Watch Video Solution

514. Write mathematical form of tangent law in magnetism.

Watch Video Solution

515. To work with a tangent galvanometer, how do you set its coil?

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516. A bar magnet AB is cut into two equal parts one part is kept over the other so that pole C_2 is above C_1. If M is magnetic moment of original magnet, what will be the magnetic moment of the combination so formed?

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517. An electric current of $0 \cdot 25A$ flows in a loop of radius $0 \cdot 2cm$. What is the magnitude of dipole moment?

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518. Two circular loops of radii r and 2r have currents I and $I/2$ flowing through them in clockwise and anticlockwise sense respectively. If their equivalent magnetic moments are M_1 and M_2, what is the relation between M_1 and M_2?

Watch Video Solution

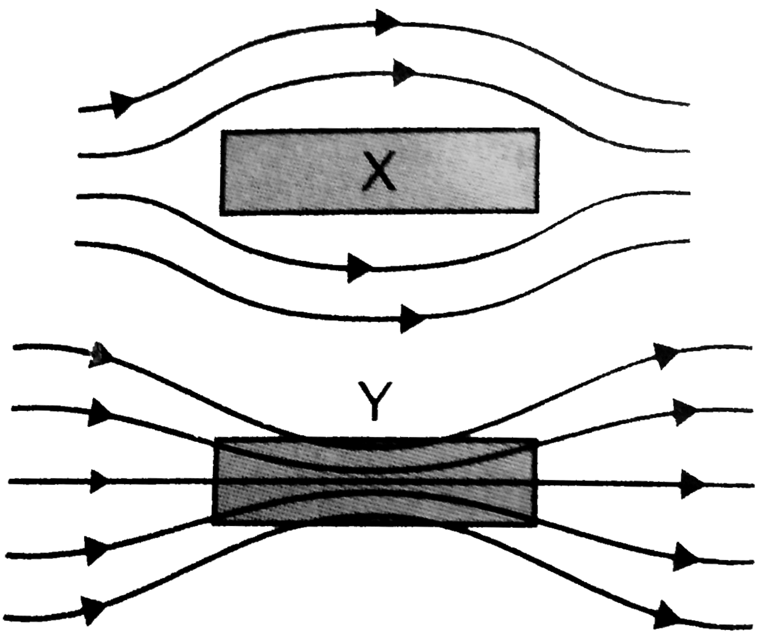
519. State two methods to destroy the magnetism of a magnet.

Watch Video Solution

520. Define the term: magnetic dipole moment of a current loop. Write the expression for the magnetic moment when an electron revolves at a speed v around an orbit of radius r in hydrogen atom.

Watch Video Solution

521. A uniform magnetic field gets modified as shown in figure. When two specimens X and Y are placed in it. Identify the specimen X and Y.



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522. Identify the materials, which can be classified as paramagnetic and diamagnetic: Al, Bi, Cu, Na.

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523. How are wrist watches protected from powerful magnets?

Watch Video Solution

524. Why does the magnetisation of a paramagnetic salt increase on cooling?

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525. Give two characteristics of a material used for making permanent magnets.

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526. Three identical specimens of magnetic materials nickel, antimony and aluminium are kept in a non-uniform magnetic field. Draw the modifications in the field lines in each case. Justify your answer.

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527. What is the susceptibility and permeability of a perfectly diamagnetic substance?

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528. Comment on the state of magnetisation of a substance whose atoms contain odd number of electrons.

Watch Video Solution

529. Which material is used to make electromagnets and why?

Watch Video Solution

530. Which material is used in making permanent magnets and why?

Watch Video Solution

531. Why is soft iron preferred for making the core of a transformer?

Watch Video Solution

532. What is the basic difference between the atom/molecule of a diamagnetic and a paramagnetic material? Why are elements with even atomic number more likely to be diamagnetic?

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533. Suppose you have two bars of identical dimensions, one made of paramagnetic substance and the other of diamagnetic substance. If you place these bars along a uniform magnetic field, show diagramatically what modification in the field pattern would take place in each case.

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534. In what way is the behaviour of a diamagnetic material different from that of a paramagnetic material, when kept in an external magnetic field?

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535. Out of the two magnetic materials. 'A' has relative permeability slightly greater than unity while 'B' has less than unity. Identify the nature of materials 'A' and 'B'. Will their susceptibilities be positive or negative?

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536. Describe Oersted's experiment and explain the law by which direction of magnetic field produced can be accounted.

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537. What do you understand by magnetic field? Define its strength and SI unit and give its dimensional formula.

Watch Video Solution

538. What is the force acting on a moving charge in a uniform magnetic field? Discuss the cases when the force is maximum and minimum and define the unit of magnetic field $\vec{B}$.

Watch Video Solution

539. What is magnetic field? State and explain Biot-Savart law.

Watch Video Solution

540. Derive an expression for magnetic field strength B at a point P due to current flowing through a straight conductor using Biot Savart's law.

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Watch Video Solution

541. State the Biot-Savart's law for the magnetic field due to a current carrying element. Use this law to obtain a formula for magnetic field at the center of a circular loop of radius R carrying a steady current I, sketch the magnetic field lines for a current loop clearly indicating the direction of the field.

Watch Video Solution

542. State the Biot-Savart's law for the magnetic field due to a current carrying element. Use this law to obtain a formula for magnetic field at the centre of a circular loop of radius R carrying a steady current I, sketch the magnetic field lines for a current loop clearly indicating the direction of the field.

Watch Video Solution

543. State Ampere's circuital law, expressing it in integral form.

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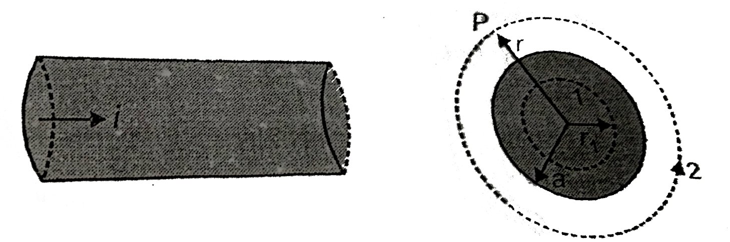
544. Figure shows a long straight wire of a circular cross-section (radius a) carrying steady current I. The current I is uniformly distributed across this cross-section. Calculate the magnetic field in the region $r < a$ and $r > a$



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545. A long solenoid with closely wound turns has n turns per unit of its length. A steady current I flows through this solenoid. Use Ampere's circuital law to obtain an expression, for the magnetic field, at a point on its axis and close to its mid point.

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546. State Ampere's circuital law. Use this law to obtain the expression for the magnetic field inside an air cored toroid of average radius r having n-turns per unit length and carrying a steady current I.

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547. Discuss the motion of a charged particle when subjected to a perpendicular uniform electric field.

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548. Discuss the motion of a charged particle when subjected to a uniform magnetic field, when the direction of motion of the particle makes an angle ϕ with the direction of magnetic field.

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549. Write the expression for the force $\vec{F}$, acting on a charged particle of charge q moving with a velocity $\vec{v}$ in the pressure of both electric field $\vec{E}$ and magnetic field $\vec{B}$. Obtain the condition under which the particle moves undeflected through the fields.

Watch Video Solution

550. (a) Write the expression for the force $\vec{F}$ acting on a particle of mass m and charge q moving with velocity $\vec{v}$ in a magnetic field $\vec{B}$. Under what conditions will it move in (a) a circular path and (ii) a hetical path?

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551. Write and explain the expression of Lorextz force. What is the magnetic dipole moment of a current loop? In what direction does it act.

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552. Explain the principle and working of a cyclotron with the help of a schematic diagram. Write the expression for cyclotron frequency.

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553. Find the force on a current carrying conductor placed in the uniform magnetic field. Name the instrument in which this is used as a working principle.

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554. Find the force between two parallel conductors carrying currents (i) in the same direction (ii) in opposite directions and hence define one ampere.

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555. Prove that two parallel current elements exert equal and opposite force on each other.

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556. What is the force that a conductor of length dl carrying a current I, experience when placed in a magnetic field $\vec{B}$? What is the direction of this force?

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557. Derive an expression for the maximum force experienced by a straight conductor of length l, carrying a current I and kept in a uniform magnetic field B.

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558. Derive an expression for the force between two long parallel current carrying conductors. Use this expression to define SI unit of current.

559. (i) Write the expression for the magnetic moment $(\vec{m})$ due to a planar square loop of side 'l' carrying a steady current I in a vector form.

(ii) In figure., this loop is placed in a horizontal plane near a long straight conductor carrying a steady current I_1 at a distance l as shown. Give reasons to explain that the loop will experience a net force but no torque. Write the expression for this force acting on the loop.

560. A rectangular coil of sides l and b carrying a current I is subjected to a uniform magnetic field $\vec{B}$ acting at an angle θ to its plane. Write the expression for the torque acting on it. In which orientation of the coil in the magnetic field, the torque is (i) minimum and (ii) maximum.

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561. Define current sensitivity and voltage sensitivity of a moving coil galvanometer. How can a galvanometer be made more sensitive?

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562. What is shunt? State its uses. Find the relation for the current through shunt in terms of resistance of galvanometer and shunt.

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563. What is an ammeter? How can a galvanometer be converted into an ammeter? Explain.

Watch Video Solution

564. What is a voltmeter? How can a galvanometer be converted into a voltmeter? Explain.

Watch Video Solution

565. Discuss the basic properties of a magnet.

Watch Video Solution

566. What are the magnetic lines of force? Give their important properties.

Watch Video Solution

567. Define magnetic dipole moment. What are its units? Is it a scalar or a vector?

Watch Video Solution

568. What is the magnetic dipole moment of a current loop? In what direction does it act?

Watch Video Solution

569. What is magnetic dipole moment? Calculate the magnetic dipole moment of a revolving electron.

Watch Video Solution

570. Draw the magnetic field lines due to a circular loop of area $\vec{A}$ carrying current I. Show that it acts as a bar magnet of magnetic moment.

$\vec{M} = I\vec{A}$

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571. Derive an expression for the magnetic field due to a solenoid of length $2l$, radius a, having n number of turns per unit length and carrying a steady current I, at a point on the axial line, distant r from the centre of the solenoid. How does this expression compare with the axial magnetic field due to a bar magnet of magnetic moment M?

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572. In a current carrying solenoid, current is flowing clockwise from left end. Draw the magnetic field produced in it.

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573. Define strength of magnetic field. Obatain an expression for strength of magnetic field on the axis of a bar magnet.

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574. Derive an expression for torque acting on a bar magnet held at an angle with the direction of a uniform magnetic field.

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575. Calculate potential energy of a magnetic dipole in a magnetic field.

Watch Video Solution

576. Find expression for work done in rotating a bar magnet in a uniform magnetic field.

Watch Video Solution

577. What is Gauss's law in magnetism? What does it signify?

Watch Video Solution

578. What is the probable cause of earth's mangetism?

Watch Video Solution

579. What are magnetic elements at a place? Define them.

Watch Video Solution

580. Define the term angle of dip and declination.

Watch Video Solution

581. State tangent law in magnetism. Which are the two required magnetic fields in a tangent galvanometer?

Watch Video Solution

582. State tangent law in magnetism. How will the reduction factor of a tangent galvanometer change when the number of turns of its coil is doubled? Explain.

Watch Video Solution

583. Deduce an expression for the magnetic dipole moment of an electron orbiting around the central nucleus.

Watch Video Solution

584. Explain magnetic permeability, magnetising force and magnetic field induction. State the relation between them.

Watch Video Solution

585. How will a dia, para and a ferromagnetic material behave when kept in a non-uniform external magnetic field? Give on example of each of these materials.

Watch Video Solution

586. Explain paramagnetism on the basis of electron theory.

Watch Video Solution

587. Distinguish between dia and para magnetic substances.

Watch Video Solution

588. State and explain Curie law in magnetism.

Watch Video Solution

589. Define the term retentivity and coercivity.

Watch Video Solution

590. What is meant by hysteresis loss? Where is the study of hysteresis used?

Watch Video Solution

591. Explain magnetic properties of soft iron and steel.

Watch Video Solution

592. Permanent magnets are made of steel while the core of transformers is made of soft iron. Why?

Watch Video Solution

593. Discuss briefly the uses of ferromagnetics.

Watch Video Solution

594. Write any two differences between electromagnet and permanent magnet.

Watch Video Solution

595. Mention two charateristic properties of the material suitable for making core of a transformer.

Watch Video Solution

596. Find the magnetic field induction (in magnitude and direction) at a point due to current flowing in a long straight conductor. Show the sketch of magnetic field produced.

Watch Video Solution

597. State the Biot-Savart's law for the magnetic field due to a current carrying element. Use this law to obtain a formula for magnetic field at the centre of a circular loop of radius R carrying a steady current I, sketch the magnetic field lines for a current loop clearly indicating the direction of the field.

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598. Find the magnetic field induction at a point on the axis of a circular coil carrying current and hence find the magnetic field at the centre of circular coil carrying current.

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599. Derive an expression for the magnetic field along the axis of an air-cored solenoid, using Ampere's circuital law. Sketch the magnetic field lines for a finite solenoid. Explain why the field at the exterior mid point is weak while at the interior it is uniform and strong.

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600. What is a cyclotron? Discuss its construction, working and theory. Explain cyclotron frequency.

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601. Draw a neat and labelled diagram of a cyclotron. State the underlying principle and explain how a positively charged particle gets accelerated in this machine. Show mathematically that the cyclotron frequency does not depend upon the speed of the particle.

Watch Video Solution

602. With the help of labelled diagram, state the underlying principle of a cylclotron. Explain clearly how it works to accelerate the charged particles to high energies.

Show that cyclotron frequency is independent of energy of the particle. Is there an upper limit on the enregy acquired by the particle? Give reason.

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603. Derive an expression for the force acting on a current carrying conductor placed in a uniform magnetic field. Name the rule which gives the direction of the force. Write the condition for which this force will have (i) maximum (ii) minimum value.

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604. Derive an expression for the maximum force experienced by a straight conductor of length l, carrying a current I and kept in a uniform magnetic field B.

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605. Discuss the principle, construction and theory of a dead beat galvanometer. State two merits of moving coil galvanometer.

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606. Draw a labelled diagram of a moving coil galvanometer. State the principle on which it works. Deduce an expression for the torque acting on a rectangular current carrying loop kept in a uniform magnetic field. Write two factors on which the current sensitivity of a moving coil galvanometer depend.

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607. Describe the working principle of a moving coil galvanometer. Why is it necessary to use (i) a radial magnetic field and (ii) a

cylindrical soft iron core in a galvanometer? Write the expression for current sensitivity of the galvanometer.

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608. Explain sensitivity of moving coil galvanometer. Show with the help of a circuit diagram that how a moving coil galvanometer can be converted into an ammeter of given range. Write necessary mathematical relation. What is the resistance of ideal ammeter?

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609. Depict the field line pattern due to a current carrying solenoid of finite length.

(i) In what way do these lines differ from those due to an electric dipole.

(ii) Why can't two magnetic field lines intersect each other?

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610. What is the evidence of terrestrial magnetism? How is it accounted for?

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611. What are the magnetic elements of earth? Explain them briefly?

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612. Explain what is meant by neutral points? How will you calculate magnetic moment of a bar magnet by locating the neutral points?

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Watch Video Solution

613. State and prove tangent law in magnetism. Give two factors by which tangent galvanometer can be made more sensitive.

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614. Describe the principle, construction, theory and working of a tangent galvanometer.

Watch Video Solution

615. Define magnetising field, magnetic induction, permeability, intensity of magnetisation and susceptibility. Establish relation between permeability and susceptibility.

Watch Video Solution

616. Distinguish between the magnetic properties of dia, para and ferromagnetic substances in terms of (i) susceptibility

(ii) magnetic permeability and

(iii) Coercivity. Give one example of each of these materials.

Draw the field lines due to an external magnetic field near a (i) diamagnetic

(ii) paramagnetic substance.

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617. What are dia, para and ferro magnetic materials? Discuss their important properties.

Watch Video Solution

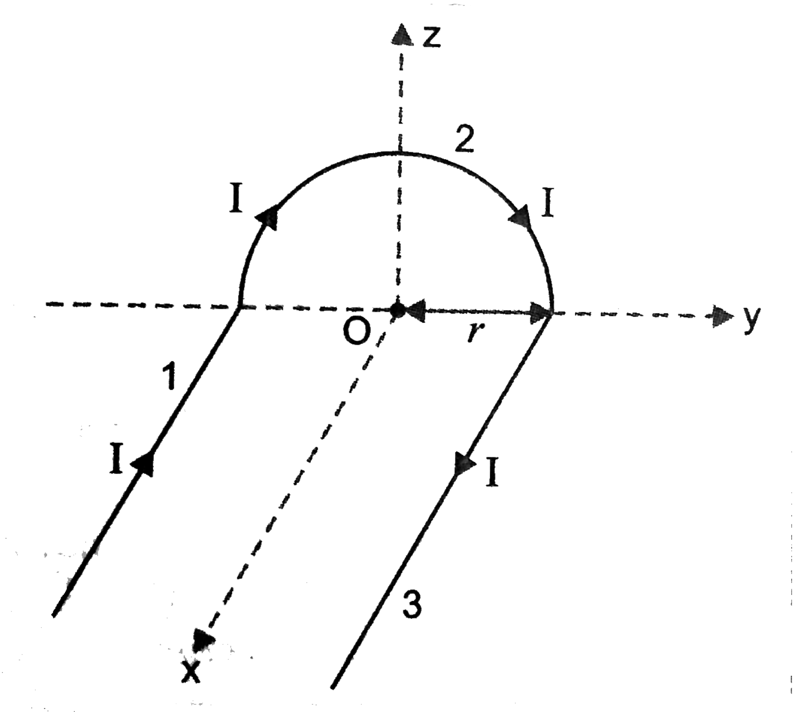
618. Discuss briefly electron theory of magnetism. How does it account for the three kinds of behaviour of magnetic substance?

Watch Video Solution

619. What is meant by hysteresis? Discuss briefly the dissipation of energy due to hysteresis. Draw hysteresis curves to soft iron and steel.

Watch Video Solution

620. Find the magnetic field induction at a point O if the wire carrying current $I = 8 \cdot 0A$ has a shape as shown in figure. The radius of the curved path of the other wire is $r = 100mm$ and linear paths of wire are very long.



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621. A long straight telephone cable contains six wires, each carrying a current of $0 \cdot 5A$. The distance between wires can be neglected. What is the magnitude of the magnetic field at a distance $10cm$ from the cable, (i) if the currents in all the six wires are in the same direction (b) if four wires carry currents in one direction and the other two in opposite direction?

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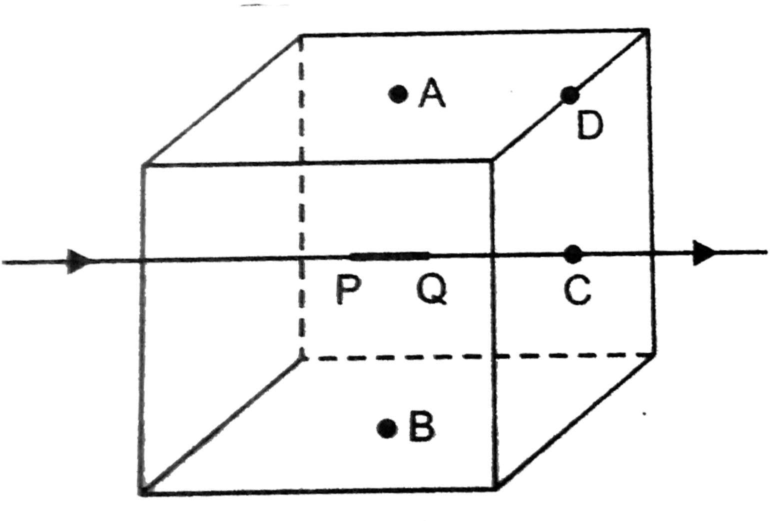
622. A long straight wire, carrying a current of $200A$, runs through a cubical wooden box, entering and leaving through holes in the centres of opposite faces Figure. The length of each side of the box is $20cm$. Consider an element PQ of the wire of $1cm$ long at the centre of the box. Calculate the magnitude of the magnetic field produced by this element at the points A, B, C and D as shown in figure. The points A, B and C are at the centres of the faces of the cube and the point D is at the mid point of one edge.



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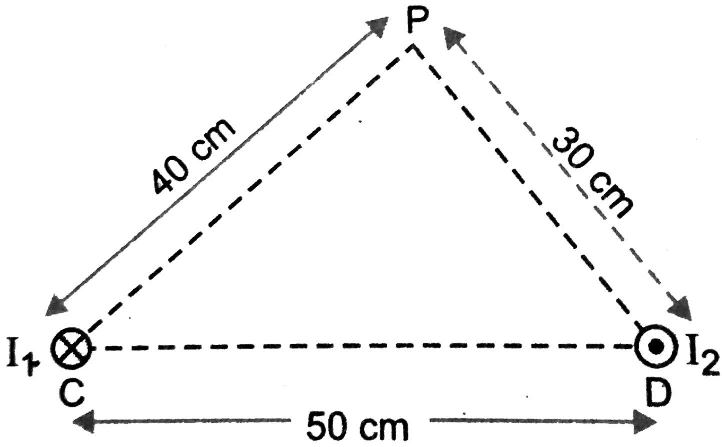
623. Two straight parallel conductors are $50 cm$ apart and carry oppositively directed currents, held perpendicular to the plane of paper as shown in figure. The current in first conductor, $I_1 = 20A$ and in the second conductor is $I_2 = 24A$. A point P is separated from the first conductor by a distance of $40 cm$ and the second conductor by $30cm$. Calculate the magnetic field at point P.



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624. A coil carrying a current $10mA$ is placed in a uniform magnetic field so that its axis coincides with the field direction. The single layer winding of the coil is made of copper wire with diameter $0 \cdot 1mm$, radius of turns is equal to $30mm$. At what value of the induction of the external magnetic field can the coil winding be ruptured? Breaking stress is $3 \cdot 1 \times 10^8 Nm^{-2}$.

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625. A direct current $I = 10A$ flows in a long straight round conductor. Find the magnetic flux through a half of the wire's cross-section per one meter of its length.

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626. A non-conducting thin disc of radius R charged uniformly over one side with surface density σ, rotates about its axis with an angular velocity ω. Find (a) the magnetic field induction at the centre of the disc (b) the magnetic moment of the disc.

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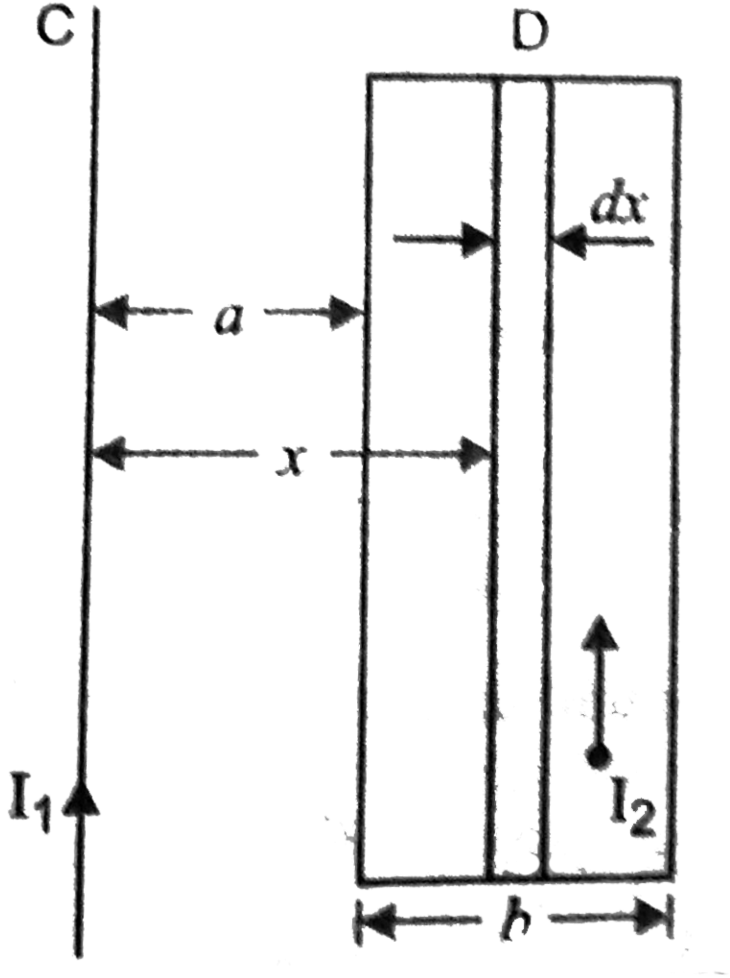
627. Two long thin parallel conductors C and D of the shape as shown in figure. Carry currents I_1 and I_2. The separation between the conductors is a, the width of the right hand conductor is equal to b. Both the conductors are lying in one plane. Find the magnetic interaction force between them reduced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



628. A system consists of two parallel plane carrying currents producing a uniform magnetic field of induction B between the planes. Outside this space there is no magnetic field. The magnetic force acting per unit area of each plane is found to be $B^2/N\mu_0$. Find N.

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

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630. An α - particle is accelerated by a potential difference of $10^4 V$. Find the change in its direction of motion, if it enters

normally in a region of thickness 0.1 m having transverse magnetic induction of 0.1 tesla. (Given: mass of α - particle 6.4×10^{-27}kg).

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631. A copper conductor of length $10cm$ and radius $1 \cdot 5mm$ is connected in parallel to an ammeter having a resistance of $0 \cdot 03\Omega$. Find the current in the circuit if the ammeter indicates $0 \cdot 4A$. The resistivity of copper is $1 \cdot 78 \times 10^{-8}\Omega m$.

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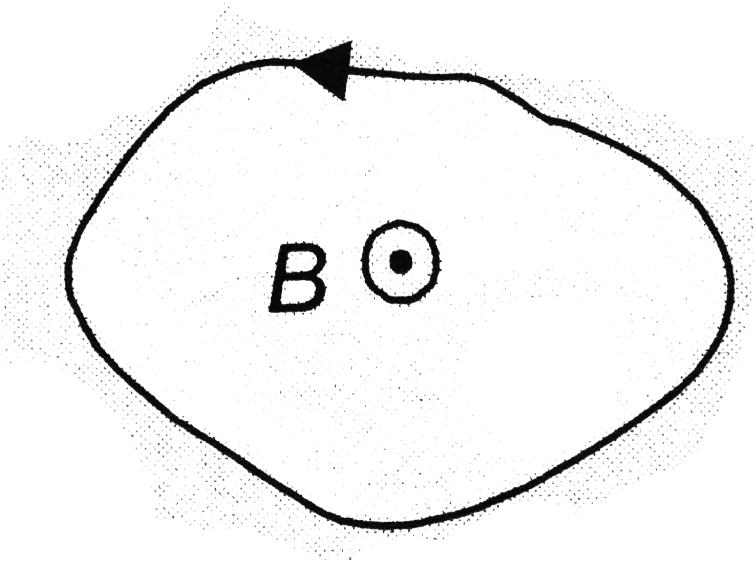
632. A loop of flexible conducting wire of length 0.5 m lies in a magnetic field of 1.0 T perpendicular to the plane of the loop. Show that when a current as shown in Fig. 1.112 is passed through the loop, it opens into a circle. Also calculate the tension developed in the wire if the current is 1.57 A.



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633. Two identical magnetic dipoles of magnetic moments $1 \cdot 0 Am^2$ each are placed at a separation of $2m$ with their axes perpendicular to each other. What is the resultant magnetic field at a point midway between the dipoles?

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634. A bar magnetic with poles $25cm$ apart and pole strength $14 \cdot 4A.m$ rests with its centre on a frictionless pivot. It is held in equilibrium at 60° to a uniform magnetic field of induction $0 \cdot 25T$ by applying a force F at right angles to its axis, $10cm$ from the pivot. Calculate the value of F. What will happen if the force is removed?

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635. A $6cm$ long bar magnet possesing magentic dipole moment $0 \cdot 3Am^2$ is placed vertically on a horizontal wooden table with north pole of magnet touching the table. A neutral point is found on the table at a distance of $8cm$ south of the magnet. Calculate the horizontal component of earth's magnetic field.

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636. A compass needle whose magnetic moment is $60Am^2$ pointing geographic north at a certain place, where the horizontal component of earth's magnetic field is $40\mu Wb/m^2$, experience a torque $1 \cdot 2 \times 10^{-3}Nm$. What is the declination of the place?

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637. A small bar magnet having magnetic moment of $9 \times 10^9 Wb - m$ is suspended at its centre of gravity by a light torsionless string at a distance of $1m$ vertically above a long straight horizontally wire carrying a current of $1A$. Find the frequency of oscillation of the magnet about its equilibrium position, assuming that the motion is undamped. The moment of inertia of the magnet is $6 \times 10^{-9}kgm^2$.

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638. The magnetic field B and the magnetic intensity H in a material are found to be $1 \cdot 6T$ and $1000Am^{-1}$, respectively. Calculate the relative permeability μ_r and susceptibility of the material. What is the nature of the material?

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639. For a magnetising field of intensity $2 \times 10^3 A/m$, aluminium at $280K$ acquires intensity of magnetisation of $4 \cdot 8 \times 10^{-2} Am^{-1}$. Find the susceptibility of aluminium at $280K$. If the temperature of the metal is raised to $320K$, what will be its susceptibility and intensity of magnetisation?

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640. A circular coil of wire consisting of 100 turns, each of radius $8 \cdot 0cm$ carries a current of $0 \cdot 40A$.

What is the magnetude of the magnetic field $\vec{B}$ at the centre of the coil?

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641. A long straight wire carries a current of $35A$. What is the magnetic of the field $\vec{B}$ at a point $20cm$ from the wire?

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642. A long straight wire in the horizontal plane carries a current of 50A in north to south direction. Give the magnitude and direction of $\vec{B}$ at a point $2 \cdot 5m$ east of the wire.

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643. A horizontal overhead power lines carries a current of 90 A in east to west direction. What is the magnitude and direction of the magnetic field due to the current $1 \cdot 5m$ below the line?

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644. What is the magnitude of the magnetic force per unit length on a wire carrying a current of 8 A making an angle of 30° with the direction of a uniform magnetic field of $0 \cdot 15T$?

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645. A $3 \cdot 0cm$ wire carrying a current of $10A$ is placed inside a solenoid perpendicular to its axis. The magnetic field inside the

solenoid is given to be $0 \cdot 27T$. What is the magnetic force on the wire?

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646. Two long and parallel straight wires A and B carrying currents of $8 \cdot 0A$ and $5 \cdot 0A$ in the same direction are separated by a distance of $4 \cdot 0cm$. Estimate the force on a $10cm$ section of wire A.

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647. A closely wound solenoid $80cm$ long has layers of windings of $400turns$ each. The diameter of the solenoid is $1 \cdot 8cm$. If the current carried is $8 \cdot 0A$ estimate the magnitude of $\vec{B}$ inside the solenoid near its centre.

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648. A square coil of side 10 cm consists of 20 turns and carries a current of 12A. The coil is suspended vertically and normal to the plane of the coil, makes an angle of 30° with the direction of a uniform horizontal magnetic field of magnitude 0.80T. What is the magnitude of torque experienced by the coil?

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649. Two moving coil meters M_1 and M_2 have the following particulars:

$R_1 = 10\Omega, N_1 = 30, A_1 = 3 \cdot 6 \times 10^{-3} m^2, B_1 = 0 \cdot 25T,$

$R_2 = 14\Omega, N_2 = 42, A_2 = 1 \cdot 8 \times 10^{-3} m^2, B_2 = 0 \cdot 50T$

(The spring constants are identical for the two metres). Determine the ratio of (a) current sensitivity and (b) voltage sensitivity of M_2 and M_1.

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650. In a chamber, a uniform magnetic field of $6 \cdot 5G\left(1G = 10^{-4}T\right)$ is maintained. An electron is shot into the field with a speed of $4 \cdot 8 \times 10^{6} ms^{-1}$ normal to the field. (i) Explain why the path of the electron is a circle. Determine the radius of the circular orbit. $\left(e = 1 \cdot 6 \times 10^{-19}C, m_e = 9 \cdot 1 \times 10^{-31}kg\right)$.

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651. In obtain the frequency of revolution of the electron in its circular orbit. Does the answer depend on the speed of the electron? Explain.

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652. (a) A circular coil of 30 turns and radius $8.0cm$. Carrying a current of $6.0A$ is suspended vertically in a uniform horizontal magnetic field of magnitude $1.0T$. The field lines make an angle of 60° with the normal to the coil. Calculate the magnitude of the counter torque that must be applied to prevent the coil from turning.

(b) Would your answer change if the circular coil in (a) were replaced by a planar coil of some irregular shape that encloses the same area? (All other particulars are also unaltered).

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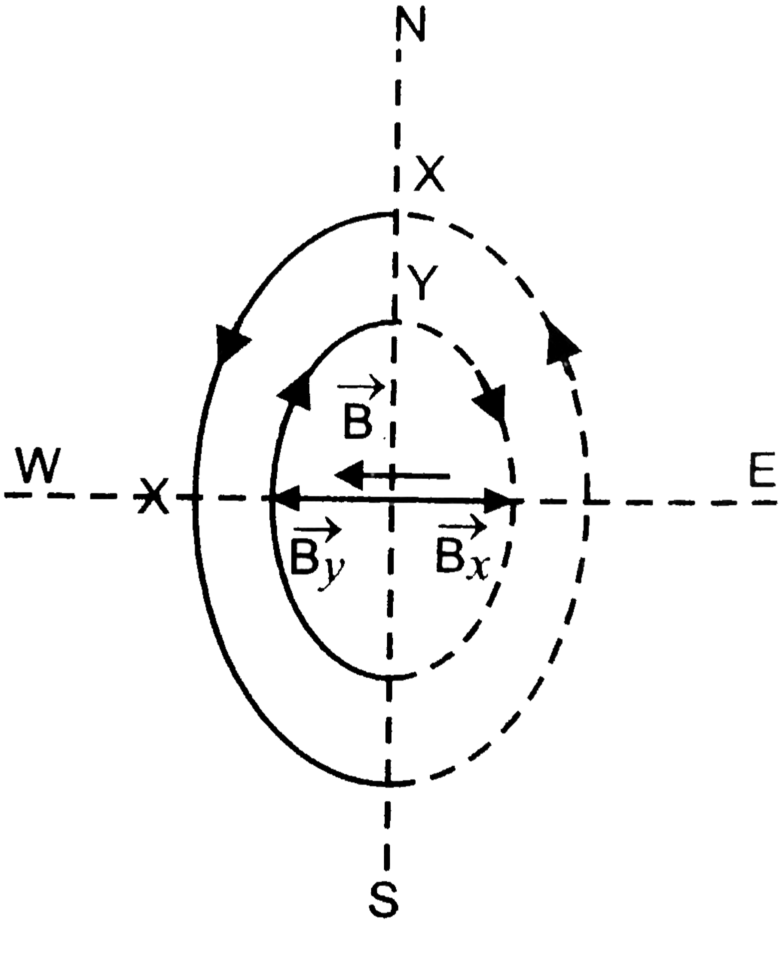
653. Two concentric coil X and Y of radii $16cm$ and $10cm$ respectively lie in the same vertical plane containing the north-south direction. Coil X has 20 turns and carries a current of 16A, coil Y has 25 turns and carries a current of 18A. The sense of current in X is anti-clockwise and in Y, clockwise, for an observer looking at the coil facing west, Figure. Give the magnitude and direction of the net magnetic field due to the coils at their centre.



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654. A magnetic field of $100G\left(1G = 10^{-4}T\right)$ is required which is uniform in a region of linear dimension about $10cm$ and area of cross section about $10^{-3}m^2$. The maximum current carrying capacity of a given coil of wire is $15A$ and the number of turns per unit length that can be wound round a core is at most $1000 turnsm^{-1}$. Suggest some appropriate design particulars of a solenoid for the required purpose. Assume the core is not ferromagnetic.

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655. For a circular coil of radius R and N turns carrying current I, the magnitude of the magnetic field at a point on its axis at a distance x from its centre is given by $B = \dfrac{\mu_0 I R^2 N}{2\left(x^2 + R^2\right)^{3/2}}$

(a) Show that this reduces to the familiar result for field at the centre of the coil.

(b) Consider two parallel coaxial circular coils of equal radius R, and number of turns N, carrying equal currents in the same direction, and separated by a distance R. Show that the field on the axis around the mid-point between the coils is uniform over a distance that is small as compared to R and is given by $B = 0 \cdot 72 \frac{\mu_0 NI}{R}$ approximately.

[Such as arrangement to produce a nearly uniform magnetic field over a small region is known as Helmholtz coils.]

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656. A toroid has a core (non ferromagnetic material) of inner radius $25cm$ and outer radius $26cm$ around which 3500 turns of wire are wound. If the current in the wire is $11A$, what is the magnetic field (a) outside the toroid (b) inside the core of the toroid (c) in the empty space surrounded by the toroid?

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657. Answer the following questions:

(a) A magnetic field that varies in magnitude from point but has a constant direction (east to west) is set up in a chamber. A charged particle enters the chamber and travles undeflected along a straight path with constant speed. What can you say about the initial velocity of the particle?

(b) A charged particle enters an environment of a strong and non-uniform magnetic field varying from point to point both in magnitude and direction, and comes out of it following a complicated trajectory. Would its final speed equal the initial speed if it suffered no collisions with the environment?

(c) An electron travelling west to east enters a chamber having a uniform electrostatic field in north to south direction. Specify the direction in which a uniform magnetic field should be set up to prevent the electron from deflecting from its straight line path.

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658. An electron emmited by a heated cathode and accelerated through a potential difference of $2 \cdot 0 kV$ enters a region with a uniform magnetic field of $0 \cdot 15 T$. Determine the trajectory of the electron if the field (a) is transverse to its initial velocity (b) makes an angle of 30° with the initial velocity.

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659. A magnetic field set up using Helmholtz coils (described in Question 16 above) is uniform in a small region and has a magnitude of $0 \cdot 75 T$. In the same region, a uniform electrostatic field is maintained in a direction normal to the common axis of the coils. A narrow beam of (single species) charged particles all accelerated through $15 kV$ enters this region in a direction perpendicular to both the axis of the coils and the electrostatic field. If the beam remains undeflected when the electrostatic field is $9 \times 10^5 Vm^{-1}$, make a simple guess so to what the beam contains. Why is the answer not unique?

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660. A straight horizontal conducting rod of length $0 \cdot 45m$ and mass $60g$ is suspended by two vertical wires at its end. A current of $5 \cdot 0A$ is set up in the rod through the wires. (a) What magnetic field should be set up normal to the conductor in order that the tension in the wires is zero? (b) What will be the total tension in the wires if the direction of current is reversed, keeping the magnetic field same as before. (Ignore the mass of the wire) $g = 9 \cdot 8ms^{-2}$.

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661. The wires which connect the battery of an automobile to its starting motor carry a current of $300A$ (for a short time). What is the force per unit length between the wires if they are $70cm$ long and $1 \cdot 5cm$ apart? Is the force attractive or repulsive?

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662. A uniform magnetic field of $1 \cdot 5T$ is in cylindrical region of radius $10 \cdot 0cm$ with its direction parallel to the axis along east to west. A wire carrying current of $7 \cdot 0A$ in the north to south direction passes through this region. What is the magnitude and direction of the force on the wire if (a) the wire intersects the axes, (b) the wire is turned from N-S to north east-south west direction, (c) the wire in the N-S direction is lowered from the axis by a distance $6 \cdot 0cm$?

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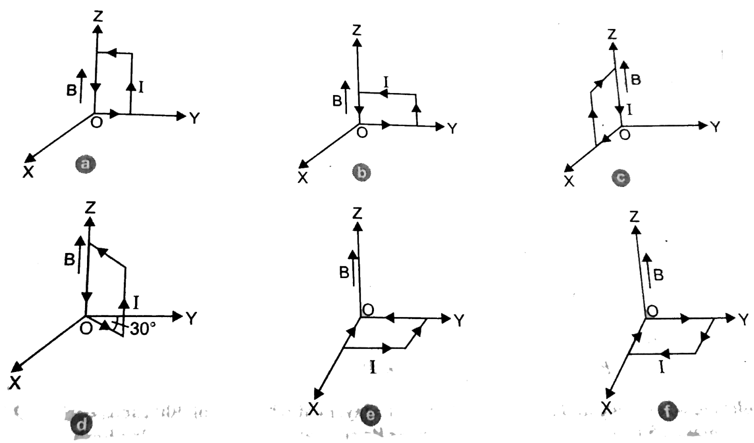
663. A uniform magnetic field of $3000G$ is established along the positive z-direction. A rectangular loop of sides $10cm$ and $5cm$ carries a current $12A$. What is the torque on the loop in the different cases shown in the figure. What is the force on each case? Which case corresponds to stable equilibrium?



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664. A circular coil of 20 turns and radius $10cm$ is placed in a uniform magnetic field of $0.10T$ normal to the place of the coil. If the current in the coil is $5.0A$, what is the

(a) total torque on the coil,

(b) total force on the coil,

(c) Given, $N = 10^{29}m^{-3}$, $A = 10^{-5}m^2$

Force on an electron of charge e, moving with drift velocity v_d in the magnetic field is given by

$$F = Bev_d = Be\frac{I}{NeA}\left(\because I = NeAv_d \right)$$

$$F = \frac{BI}{NA} = \frac{0 \cdot 10 \times 5 \cdot 0}{10^{29} \times 10^{-5}} = 5 \times 10^{-25}N$$

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665. A solenoid $60cm$ long and of radius $4 \cdot 0cm$ has 3 layers of windings of 300 turns each. A $2 \cdot 0cm$ long wire of mass $2 \cdot 5g$ lies inside the solenoid (near its centre) normal to the axis : both the wire and the axis of the solenoid are in the horizontal plane. The wire is connected through two leads parallel to the axis of solenoid to an external battery which supplies a current of $6 \cdot 0A$

in the wire. What value of current (with appropriate sense of circulation) in the windings of the solenoid can support the weight of the wire? $g = 9 \cdot 8ms^{-2}$.

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666. A galvanometer coil has a resistance of 12Ω and the meter shows full scale deflection for a current of $3mA$. How will you convert the meter into a voltmeter of range 0 to 18V?

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667. A galvanometer coil has a resistance of 15Ω and the meter shows full scale deflection for a current of $4mA$. How will you convert the meter into an ammeter of range 0 to 6A?

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668. Answer the following questions regarding earth's magnetism.

(a) A vector needs three quantities for its specification. name the three independent quantities conventionally used to specify the earth's magnetic field.

(b) The angle of dip at a location in southern india is about 18°. Would you expect a greater or lesser dip angle in Britain?

(c) If you made a map of magnetic field lines at Melbourne in Australia, would the lines seem to go into the ground or come out of the ground?

(d) Which direction would a compass needle point to, if located right on the geomagnetic north or south pole?

(e) The earth's field, it is claimed, roughly approximates the field due to a dipole of magnetic moment $8 \times 10^{22} JT^{-1}$ located at its centre. Check the order of magnetude of this number in some way.

(f) Geologists claim that besides the main magnetic n-s poles, there are several local poles on the earth's surface oriented in different directions. How is such a thing possible at all?

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669. Answer the following questions: (a) The earth's magnetic field varies from point to point in space.

Does is also change with time? If so, on what time scale does it change appreciably?

(b) The earth's core is known to contain iron. Yet geologists do not regard this as a source of earth's magnetism, why?

(c) The charged currents in the outer conducting regions of earth's core are thought to be possible for earth's magnetism. What might be the battery to sustain these currents?

(d) The earth may have even reversed the direction of its field several times during its history of 4 to 5 billion years. How can geologist know about the earth's field in such distant past?

(e) The earth's field departs from its dipole shape substantially at large distances (greater than about 30000km). What agencies may be responsible for this distortion?

(f) Interstellar space has an extremely weak magnetic field of the order of $10^{-12}T$. Can such a weak field be of any significant consequence? Explain.

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670. A short bar magnet placed with its axis at 30° with a uniform external magnetic field of $0 \cdot 25T$ experiences a torque of magnitude equal to $4 \cdot 5 \times 10^{-2}J$. What is the magnitude of magnetic moment of the magnet?

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671. A short bar magnet of moment $0 \cdot 32JT^{-1}$ is placed in a uniform external magnetic field of $0 \cdot 15T$, if the bar is free to rotate in the plane of the field, which orientations would correspond to its, (i) stable and (ii) unstable equilibrium? What is the potential energy of the magnet in each case?

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672. A closely wound solenoid of 800 turns and area of cross section $2 \cdot 5 \times 10^{-4} m^2$ carries a current of $3 \cdot 0A$. Explain the sense in which the solenoid acts like a bar magnet. What is its associated magnetic moment?

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673. If the solenoid in the above question is free to turn about the vertical direction, and a uniform horizontal magnetic field of $0 \cdot 25T$ is applied, what is the magnitude of the torque on the solenoid when its axis makes an angle of 30° with the direction of the applied field?

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674. A bar magnet of magnetic moment $1.5JT^{-1}$ lies aligned with the direction of a uniform magnetic field of $0.22T$.

(a) What is the amount of work done to turn the magnet so as to align its magnetic moment

(i) normal to the field direction, (ii) opposite to the field direction?

(b) What is the torque on the magnet in cases (i) and (ii)?

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675. A closely wound solenoid of 2000 turns and area of cross section $1.6 \times 10^{-4}m^2$, carrying a current of $4amp.$ is suspended through its centre allowing it to turn in a horizontal plane:

(a) What is the magnetic moment associated with the solenoid?

(b) What are the force and torque on the solenoid if a uniform horizontal magnetic field of $7 \cdot 5 \times 10^{-2} T$ is set up at an angle of 30° with the axis of the solenoid?

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676. A circular coil of 16 turns and radius 10cm carrying a current of 0.75A rests with its plane normal to an external field of magnitude $5 \cdot 0 \times 10^{-2} T$. The coil is free to turn about an axis in its plane perpendicular to the field direction. When the coil is turned slightly and released, it oscillates about its stable equilibrium with a frequency of $2 \cdot 0 s^{-1}$. What is the moment of inertia of the coil about its axis of rotation?

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677. A magnetic needle free to rotate in a vertical plane parallel to the magnetic meridian has its north tip pointing down at 22°

with the horizontal. The horizontal component of the earth's magnetic field at the place is known to be 0.35 G. Determine the magnitude of the earth's magnetic field at the place.

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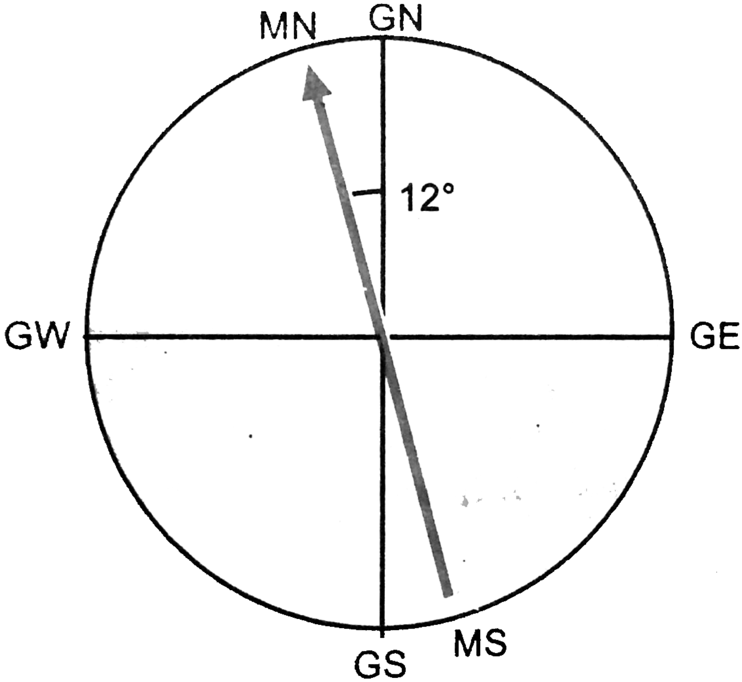
678. At a certain location in Africa, compass points 12° west of geographic north, figure. The north tip of magnetic needle of a dip circle placed in the plane of magnetic meridian points 60° above the horizontal. The horizontal component of earth's field is measured to be $0.16 gauss$. Specify the direction and magnitude of the earth's field at the location.



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679. A short bar magnet has a magnetic moment of $0 \cdot 48 JT^{-1}$.

Give the direction and magnitude of the magnetic field produced by the magnet at a distance of $10 cm$ from the centre of the magnet on (i) the axis (ii) the equatorial line (normal bisector) of the magnet.

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680. A short bar magnet placed in a horizontal plane has its axis aligned along the magnetic north south direction. Null points are found on the axis of the magnet at $14cm$ from the centre of the magnet. The earth's magnetic field at the plane is $0 \cdot 36G$ and the angle of dip is zero. What is the total magnetic field on the normal bisector of the magnet at the same distance as the null points (i.e. 14 cm) from the centre of the magnet? (At null points, field due to a magnet is equal and apposite to the horizontal component of earth's magnetic field).

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681. If the bar magnet in the above problem is turned around by 180°, where will the new null points be located?

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682. A short bar magnet of magnetic moment $5 \cdot 25 \times 10^{-2} JT^{-1}$ is placed with its axis perpendicular to earth's field direction. At what distance from the centre of the magnet, is the resultant field inclined at 45° with earth's field on (i) its normal bisector, (ii) its axis? Magnitude of earth's field at the place $0 \cdot 42G$. Ignore the length of the magnet in comparison to the distances involved.

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683. Answer the following questions:

(a) Why does a paramagnetic sample display greater magnetization (for the same magnetizing field) when cooled.

(b) Why is diamagnetism, in contrast, almost independent of temperature?

(c) If a toroid uses bismuth for its core, will the field in the core be (slightly) greater or (slightly) less than when the core is empty?

(d) Is the permeability of a ferromagnetic material independent of the magnetic field? If not, is it more for lower or higher fields?

(e) Magnetic field lines are always nearly normal to the surface of a ferromagnet at every point (This fact is analogous to the static electric field lines being normal to the surface of a conductor at every point). Why?

(f) Would the maximum possible magnetization of a paramagnetic sample be of the same order of magnitude as the magnetization of a ferromagnet?

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684. Answer the following question: (a) Explain qualitatively on the basis of domain picture, the irreversibility in the magnetisation curve of a ferromagnet.

(b) The hysteresis loop of a soft iron piece has a much smaller area than that of a carbon steel piece. If the material is to go through repeated cycles of magnetisation, which piece will dissipate greater heat energy?

(c) A system displaying a hysteresis loop such as ferromagnet is a device for strong memory? Explain the meaning of this statement.

(d) What kind of ferromagnet material is used for coating magnetic tapes in a cassette player, or for building memory stores in a modern computer?

(e) A certain region of space is to be shielded from magnetic fields. Suggest a method.

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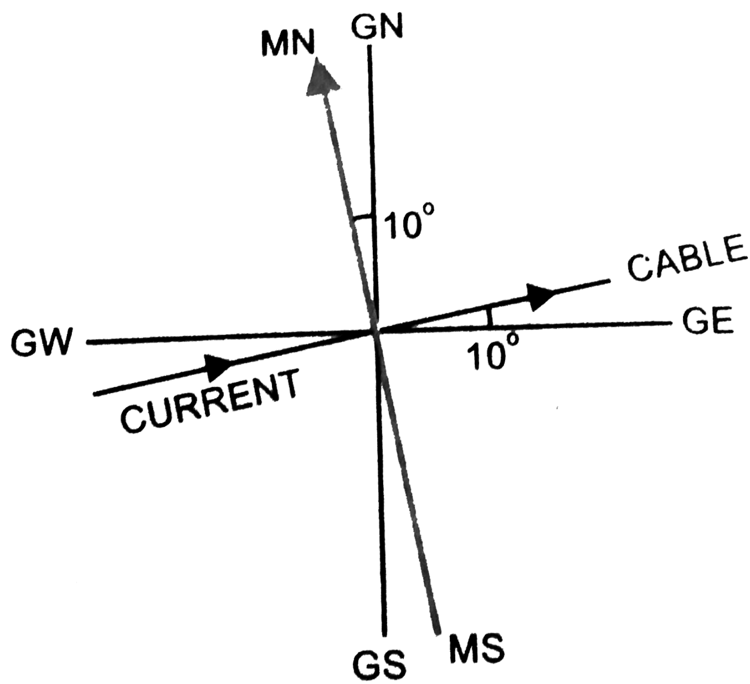
685. A long straight horizontal cable carries a current of $2.5 amp$. In the direction 10° south of west to 10° north of east, figure. The magnetic meridian of the place happens to be 10° west of the geographic meridian. The earth's magnetic field at the location is $0.33G$ and the angle of dip is zero. Locate the line of neutral points (Ignore the thickness of the cable). [At neutral points, magnetic fied due to a current cable is equal and opposite to the horizontal component of earth's magnetic field.]



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686. A telephonic cable at a place has four long straight horizontal wires carrying a current of $1.0 amp.$ in the same direction east to west. The earth's magnetic field at the place is $0.39G$ and the angle of dip is 35°. The magnetic declination is almost zero. What are the resultant magnetic fields at points $4.0cm$ below and above the cable?

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687. A compass needle free to turn in a horizontal plane is placed at the centre of a circular coil of 30 turns and radius 12 cm. The coil is in a vertical plane making an angle of 45° with the magnetic meridian when the current in the coil is $0.35 amp.$, the needle points west to east.

(a) Determine the horizontal component of earth's magnetic field at the location.

(b) The current in the coil is reversed and the coil is rotated about its vertical axis by an angle of 90° in the anticlockwise sense looking from above. Predict the direction of the needle. Take the magnetic declination at the places to be zero.

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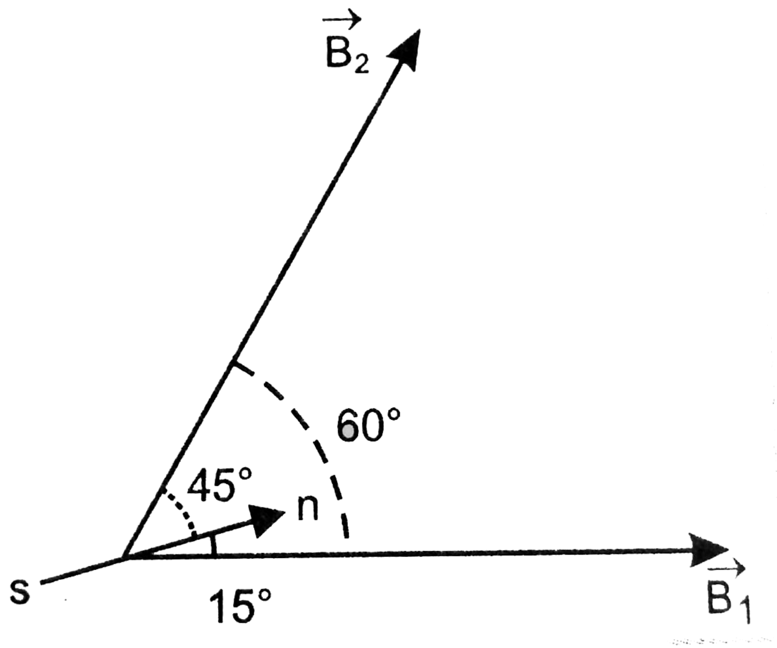
688. A magnetic dipole is under the influence of two magnetic fields. The angle between the field directions is 60° and one of the fields has a magnitude of $1 \cdot 2 \times 10^{-2}$ tesla. If the dipole comes to stable equilibrium at an angle of 15° with this field, figure, what is the magnitude of the other field?



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689. A monoenergetic $(18 keV)$ electron beam initially in the horizontal direction is subjected to a horizontal magnetic field of $0 \cdot 40 G$ normal to the initial direction. Estimate the up or down deflection of the beam over a distance of $30 cm$. Given mass of electron $9.11 \times 10^{-31} kg$ and charge on electron $= 1 \cdot 6 \times 10^{-19} C$.

[Note. Data in this exercise are so chosen that the answer will give you an idea of the effect of earth's magnetic field on the motion of electron beam from electron gun to the screen in a T.V. set].

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690. A sample of paramagnetic salt contains 2×10^{24} atomic dipoles, each of moment $1.5 \times 10^{-23} JT^{-1}$. The sample is placed under a homogeneous magnetic field of $0.64T$ and cooled to a temperature of $4.2K$. The degree of magnetic saturation archieved is equal to 15%. What is the total dipole moment of the sample for a mangetic field of $0.98T$ and a temperature of $2.8K$. (Assume Curie's law).

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691. A Rowland ring of mean radius $15cm$ has 3500 turns of wire wound on a ferromangetic core of relative permeability 800. What is the magnetic field B in the core for a magnetising current of $1 \cdot 2A$?

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692. The magnetic moment vectors $\vec{\mu}_s$ and $\vec{\mu}_l$ associated with the intrinsic spin angular momentum $\vec{S}$ and orbital angular momentum $\vec{l}$ respectively, of an electron are predicted by quantum theory (and verified experimentally to a high accuracy to be given by

$\vec{\mu}_s = -\left(\frac{e}{m}\right)\vec{S}$ and $\vec{\mu}_l = -\left(\frac{e}{2m}\right)\vec{l}$

Which of these relations is in accordance with the result expected classically? Outline the derivation of the classical result.

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693. Verify that the cyclotron frequency $\omega = eB/m$ has the correct dimensions of $[T]^{-1}$.

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694. Show that a force that does no work must be a velocity dependent force.

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695. The magnetic force depends on $\vec{v}$ which depends on the inertial frame of reference. Does then the magnetic force differ from inertial frame to frame? Is it reasonable that the net acceleration has a different value in different frames of reference?

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696. Describe the motion of a charged particle in a cyclotron if the frequency of the radio frequency (rf) field were doubled.

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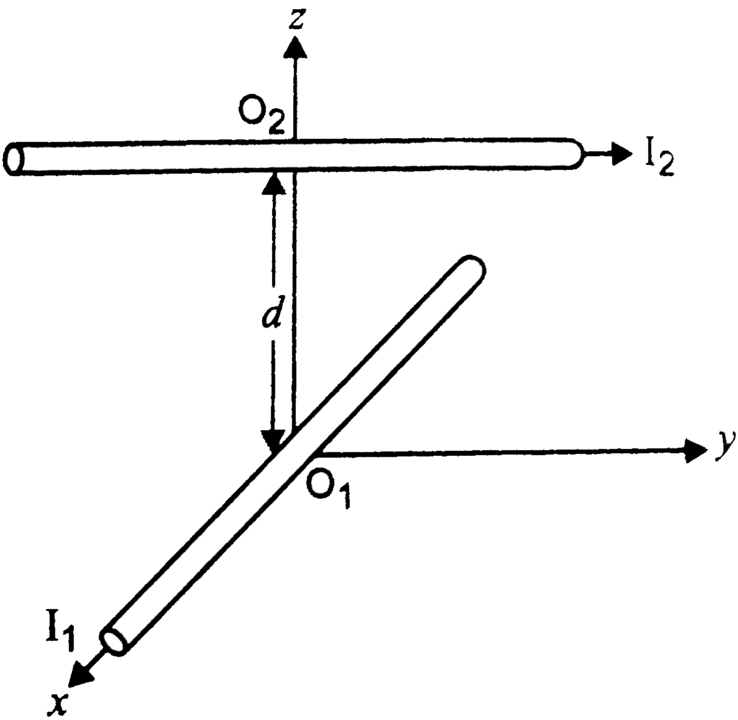
697. Two long wires carrying current I_1 and I_2 are arranged as shown in figure. The one carrying current I_1 is along the x-axis. The other carrying current I_2 is along a line parallel to the y-axis given by $x = 0$ and $z = d$. Find the force exerted at O_2 because of the wire along the x-axis.



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698. A current carrying loop consists of 3 identical quarter circles of radius R, lying in the positive quadrants of the x-y, y-z and z-x planes with their centres at the origin, joined together. Find the direction and magnitude to $\vec{B}$ at the origin.

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699. A charged particle of charge e and mass m is moving in an electric field $\vec{E}$ and magnetic field $\vec{B}$. Constant dimensionless quantities and quantities of dimention $[T]^{-1}$.

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700. An electron enters with a velocity $\vec{v} = v_0\hat{i}$ into a cubical region (faces parallel to coordinate planes) in which there are uniform electric and magnetic fields. The orbit of the electron is found to spiral down inside the cube in plane parallel to the x-y plane. Suggest a configuration of fields $\vec{E}$ and $\vec{B}$ that can lead to it.

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701. Do magnetic forces obey Newton's third law. Verify for two current elements $d\vec{l}_1 = dl\hat{i}$ located at the origin and $d\vec{l}_2 = dl\hat{j}$ located at (0, R, 0). Both carry current I.

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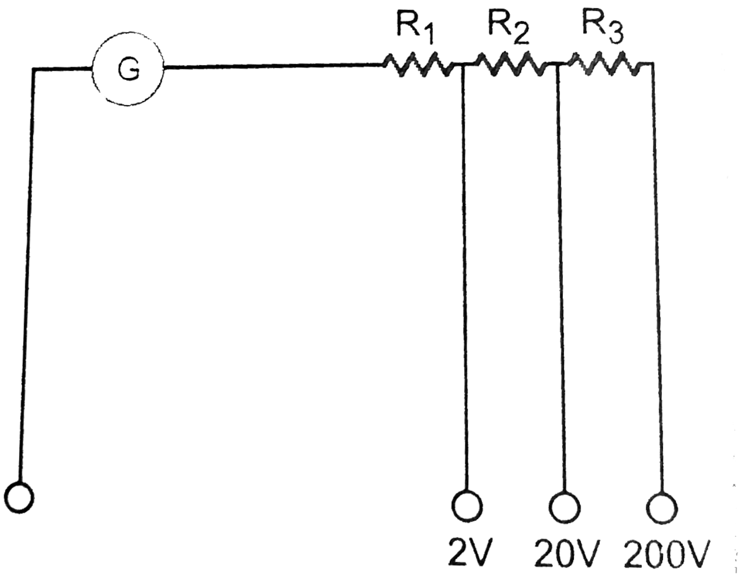
702. A multirange voltmeter can be constructed by using a galvanometer circuit as shown in figure. We want to construct a voltmeter that can measure 2V, 20V and 200V using a galvanometer of resistance 10Ω and that produces maximum deflection for current of $1mA$. Find R_1, R_2 and R_3 that have to be



used.

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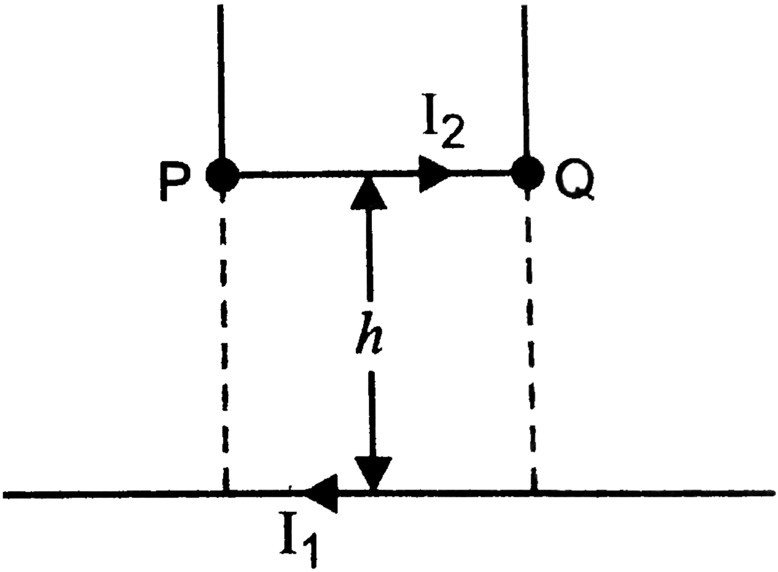
703. A long straight wire carrying current of $25A$ rests on a table as shown in figure. Another wire PQ of length 1m, mass $2 \cdot 5g$ carries the same current but in the opposite direction. The wire

PQ is free to slide up and down. To what height will PQ rise?



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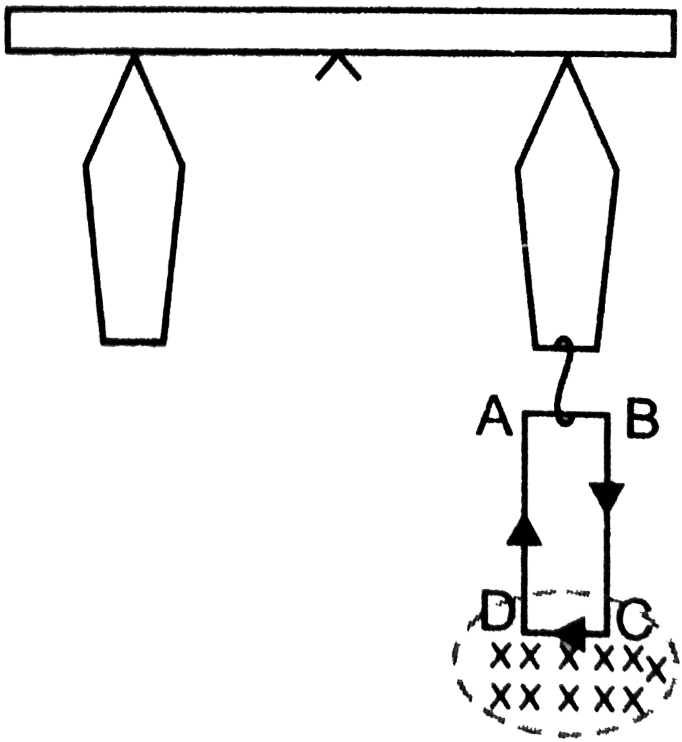
704. A 100 turn rectangular coil ABCD (in XY plane) is hung from one arm of a balance (figure). A mass $500g$ is added to the other arm to balance the weight of the coil. A current $4 \cdot 9A$ passes through the coil and a constant magnetic field of $0 \cdot 2T$ acting inward (in xz plane) is switched on such that only arm CD of length $1cm$ lies in the field. How much additional mass 'm' must be added to regain the balance?



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705. A rectangular conducting loop consists of two wires on two opposite sides of length l joined together by rods of length d. The wires are each of the same material but with cross-sections differing by a factor of 2. The thicker wire has a resistance R and the rods are of low resistance, which in turn are connected to a constant voltage source V_0. The loop is placed in a uniform magnetic field B at 45° to its plane. Find τ, the torque exerted by the magnetic field on the loop about an axis through the centres of rods.

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706. An electron and a position are released from (0, 0, 0) and $(0, 0, 1 \cdot 5R)$ respectively, in a uniform magnetic field $\vec{B} = B_0\hat{i}$, each with an equal momentum of magnitude $p = eBR$. Under what conditions on the direction of momentum will the orbits be non-intersecting circles?

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707. A uniform conducting wire of length $12a$ and resistance R is wound up as a current carrying coil in the shape of (i) an equilateral triangle of side a, (ii) a square of sides a and, (iii) a regular hexagon of sides a. The coil is connected to a voltage source V_0. Find the magnetic moment of the coils in each case.

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708. Consider a circular current-carrying loop of radius R in the x-y plane with centre at origin. Consider the line integral $\zeta(L) = \left| \int_{-L}^{L} \vec{B} . d\vec{l} \right|$ taken along z-axis.

(a) Show that $\zeta(L)$ monotonically increases with L.

(b) Use an appropriate Amperian loop to show that $\zeta(\infty) = \mu_0 I$, where I is the current in the wire.

(c) Verify directly the above result.

(d) Suppose we replace the circular coil by a square coil of sides R carrying the same current I. What can you say about $\zeta(L)$ and $\zeta(\infty)$?

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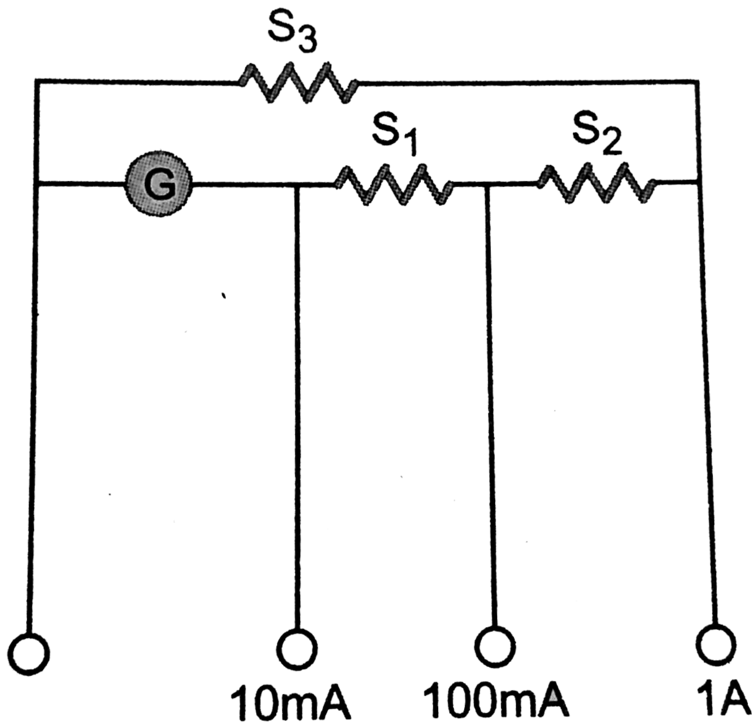
709. A multirange current meter can be constructed by using a galvanometer circuit as shown in figure. We want a current meter that can measure $10mA$, $100mA$ and $1A$ using a galvanometer of resistance 10Ω and that produces maximum deflection for current of $1mA$. Find S_1, S_2 and S_3 that have to be used.



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710. Five long wires A, B, C, D and E, each carrying current I are arranged to form edges of a pentagonal prism as shown in figure. Each carries current out of the plane of paper.

(a) What will be magnetic induction at a point on the axis O? Axis is at a distance R from each wire.

(b) What will be the field if current in one of the wires (say A) is switched off?

(c) What if current in one of the wire (say) A is reversed?

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711. A proton has spin and magnetic moment just like an electron. Why then its effect is neglected in magnetism of materials?

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712. A permanent magnet in the shape of a thin cylinder of length $10cm$ has $M = 10^6 A/m$. Calculate the magnetisation current I_M. (Here M is the intensity of magnetisation).

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713. Explain quantitatively the order of magnitude difference between the diamagnetic susceptibility of $N_2\left(-5 \times 10^{-9}\right)$ (at STP) and $Cu\left(-10^{-5}\right)$.

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714. From molecular view point, discuss the temperature dependence of susceptibility for diamagnetism, paramagnetism and ferromagnetism.

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715. A ball of superconducting material is dipped in liquid nitrogen and placed near a bar magnet. (i) In which direction will it move?

(ii) What will be the direction of it's magnetic moment?

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716. Verify the Gauss's law for magnetic field of a point dipole of dipole moment M at the origin for the surface which is a sphere of radius R.

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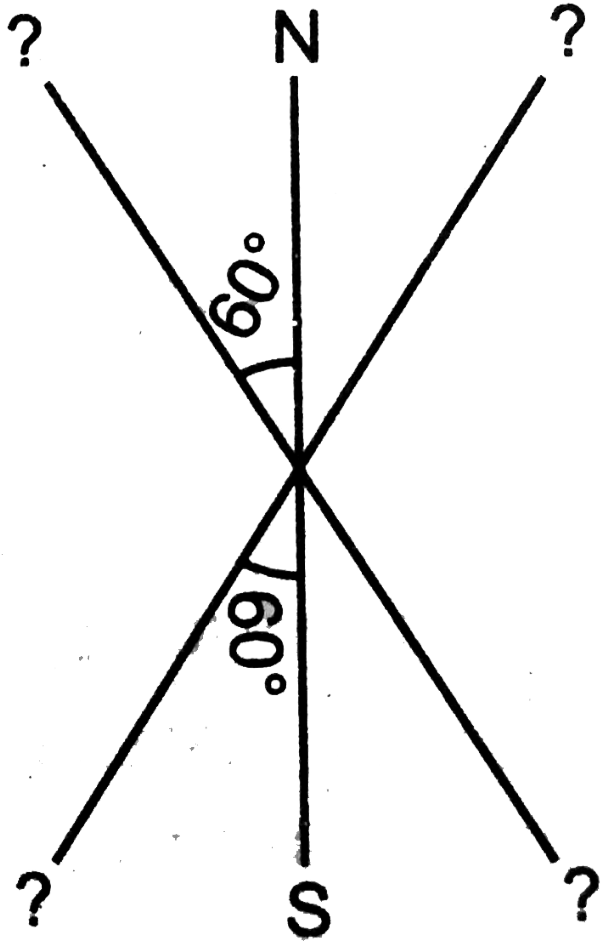
717. Three identical bar magnets are rivetted together at centre in the same place as shown in figure. This system is placed at rest in a slowly varying magnetic field. It is found that the system of magnets does not show any motion. The north-south poles of one magnet are shown in figure. Determine the poles of the remaining two.



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718. Suppose we want to verify the analogy between electrostatic and magnetostatic by an explicit experiment. Consider the motion of (i) electric dipole $\vec{p}$ in an electrostatic field $\vec{E}$ and (ii) magnetic dipole $\vec{M}$ in a magnetic field $\vec{B}$. Write down a set of conditions on $\vec{E}$, $\vec{B}$, $\vec{p}$, $\vec{M}$ so that the two motions are verified to be identical. (Assume identical initial conditions).

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719. A bar magnet of magnetic moment M and moment of inertia I (about centre, perpendicular to length) is cut into two equal pieces, perpendicular to length. Let T be the period of oscillation of the original magnet about an axis through the mid point, perpendicular to length, in a magnetic field $\vec{B}$. What would be the similar period $T^{'}$ for each piece?

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720. Verify the Ampere's law for magnetic field of a point dipole moment $\vec{M} = M\hat{k}$. Take C as the closed curve running clockwise along (i) z-axis from $z = a > 0$ to $z = R$, (ii) along the quarter circle of radius R and centre at the origin, in the first quadrant of x-z plane, (iii) along the x-axis from $x = R$ to $x = a$, and (iv) along the quarter circle of radius a and centre at the origin in the first quadrant of x-y plane.

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721. What are the dimensions of χ, the magnetic susceptibility? Consider an H-atom. Guess an expression for χ upto a constant by constructing a quantity of dimensions of χ, out of parameters of the atom: e, m, v, R and μ_0. Here, m is the electronic mass, v is electronic velocity, R is Bohr radius. Estimate the number so obtained and compare with the value of $|\chi| 10^5$ for many solid materials.

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722. Assume the dipole model of earth's magnetic field B which is given by B_V= vertical component of magnetic field $= \frac{\mu_0}{4\pi} \frac{2M\cos\theta}{r^3}$, B_H=Horizontal component of magnetic field $= \frac{\mu_0}{4\pi} \frac{\sin\theta M}{r^3}$, $\theta = 90^\circ$ - latitude as measured from magnetic equator.

Find loci of points for which (i) $\left|\vec{B}\right|$ is minimum, (ii) dip angle is zero, and (iii) dip angle is $\pm 45^\circ$.

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723. Consider the plane S formed by the dipole axis and the axis of earth. Let P be point on the magnetic equator and in S. Let Q be the point of intersection of the geographical and magnetic equators Obtain the declination and dip angles at P and Q.

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724. There are two current carrying planar coils made each from identical wires of length L. C_1 is the circular (radius R) and C_2 is square (side a). They are so constructed that they have same frequency of oscillation when they are placed in the same uniform $\vec{B}$ and carry the same current i. Find a in terms of R.

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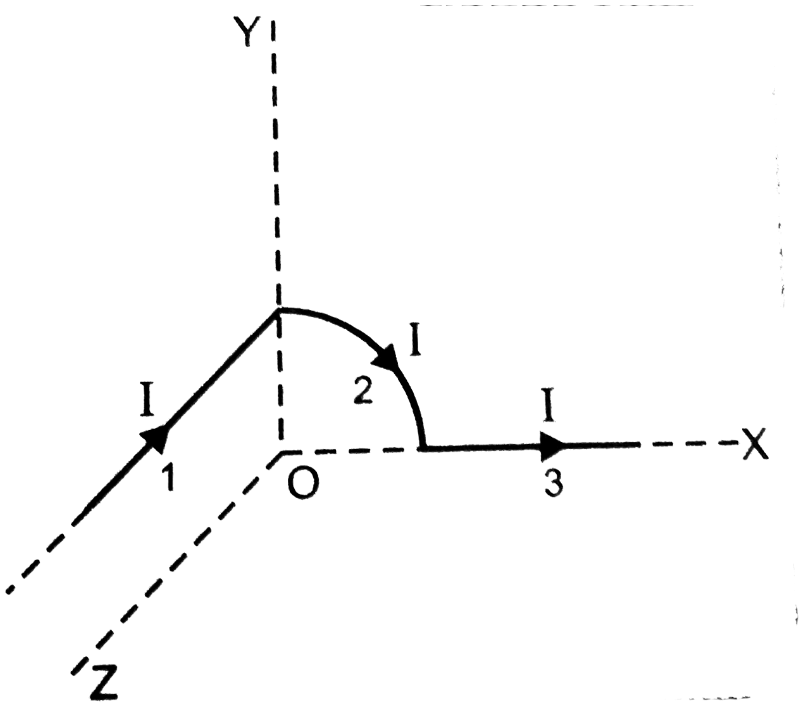
725. Find the magnitude of the magnetic field at the origin O due to very long conductor carrying current I of the shape as shown in figure.



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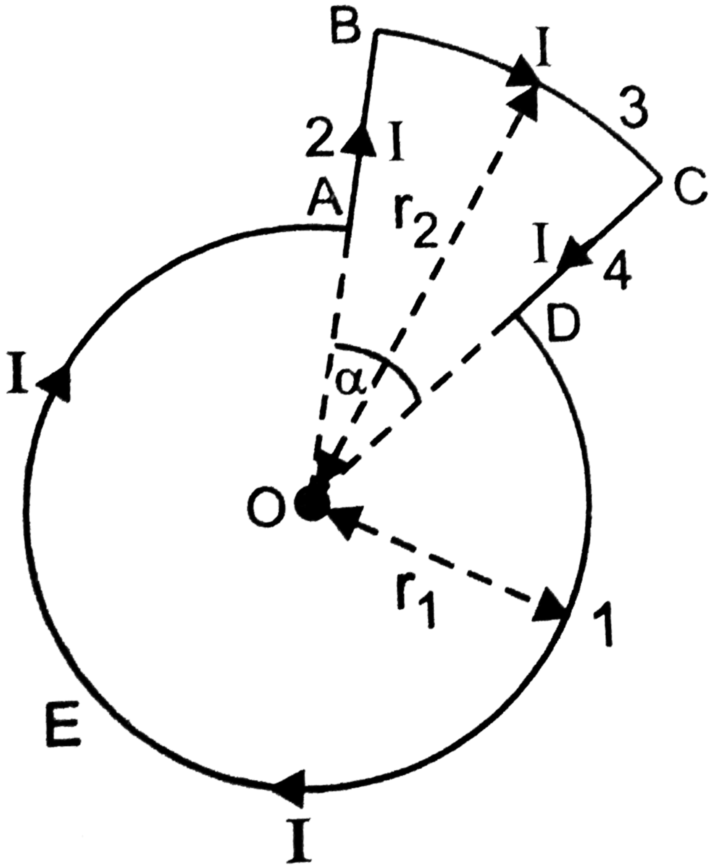
726. In the frame work of wires shown in figure, a current I ampere is flowing. Find the magnetic field at O.



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727. Show that the magnetic field along the axis of a current carrying coil of radius r at a distance x from the centre of the coil is smaller by the fraction $3x^2/2r^2$ than the field at the centre of the coil carrying current.

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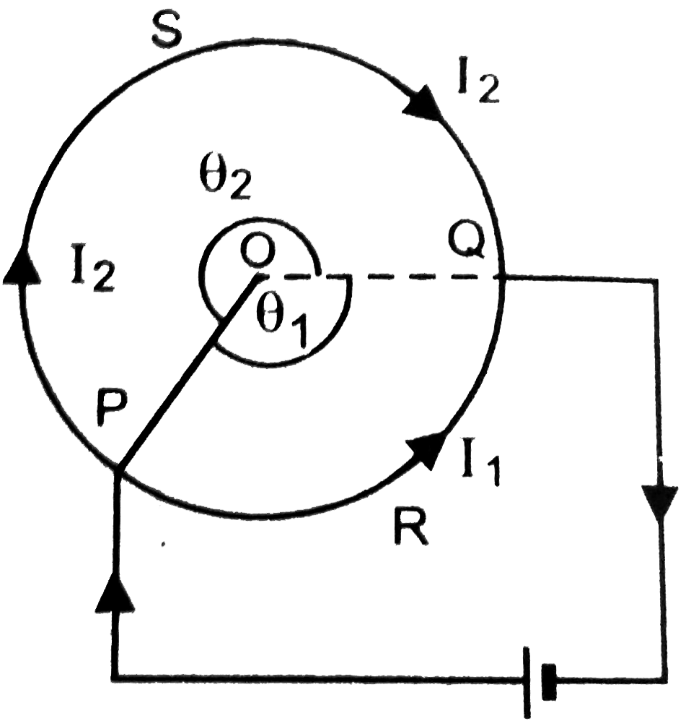
728. A cell is connected across two points P and Q of a uniform circular conductor, figure. Prove that the magnetic field at its centre O will be zero.



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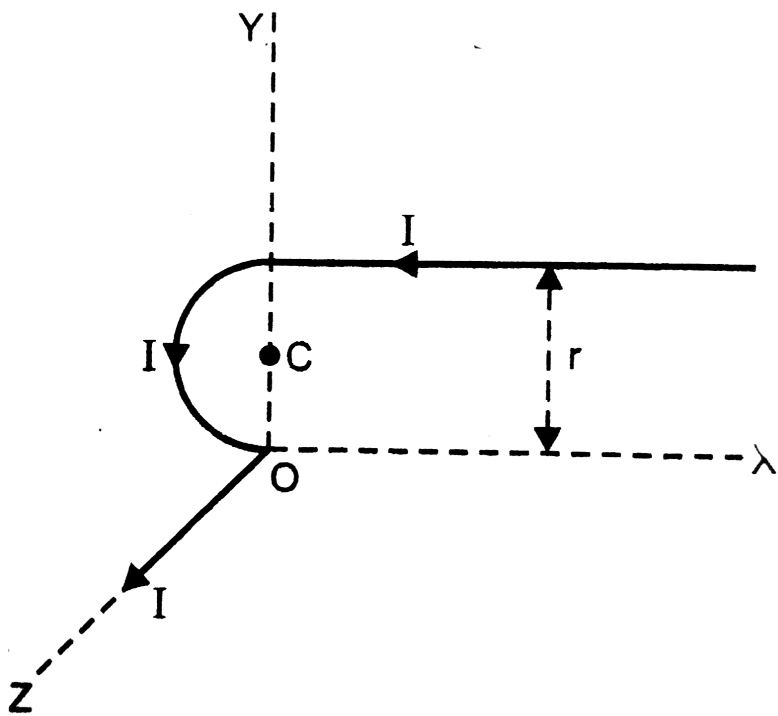
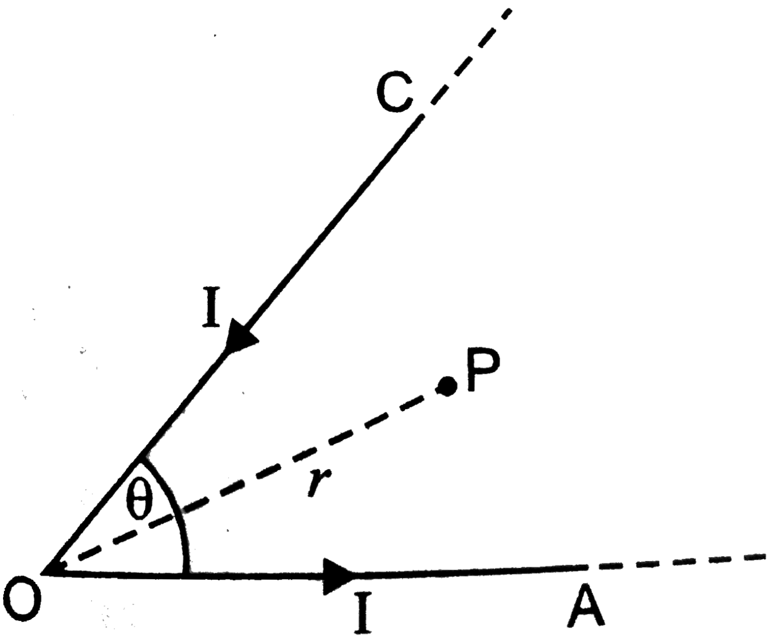
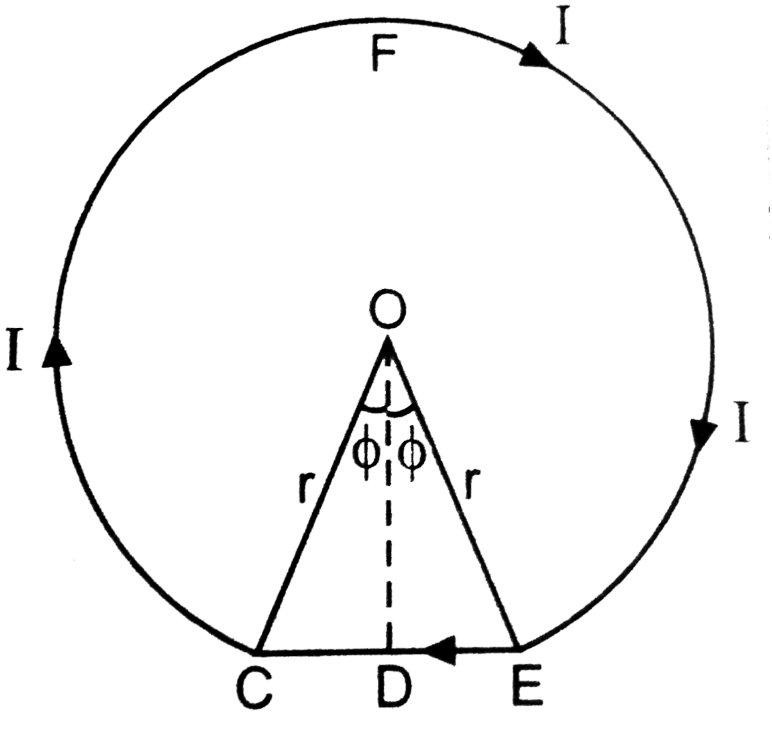
729. An infinitely long conductor as shown in figure, carrying a current I with a semicircular loop on X-Y plane and two straight parts, one parallel to X-axis and another coinciding with Z-axis. What is the magnetic field induction at the centre C of the semi-circular loop.



730. Two wires CO and OA carry equal currents I as shown in figure. One end of both the wires extends to infinity. Given $\angle AOC = \theta$. What is the magnitude of magnetic field induction at a point P at a distance r from O lying on the bisector of angle θ.



731. Find the total magnetic induction at point O due to current through curved portion and straight portion in the figure.



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732. A hollow cylindrical conductor of radii a and b carries a current I uniformly spread over its cross-section. Prove that the magnetic field induction B for point inside the body of the conductor at a distance r from the axis of cylinder is given by,

$$B = \frac{\mu_0 \mu_r I \left(r^2 - a^2\right)}{2\pi \left(b^2 - a^2\right) r}$$

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733. A beam of charged particles having kinetic energy $10^3 eV$ and containing masses $8 \times 10^{-27} kg$ and $1 \cdot 6 \times 10^{-26} kg$, emerges from the end of an accelerated tube. There is a plate at a distance $10^{-2} m$ from the end of the tube and placed perpendicular to the beam. Calculate the magnitude of the smallest magnetic field which can prevent the beam from striking the plate.

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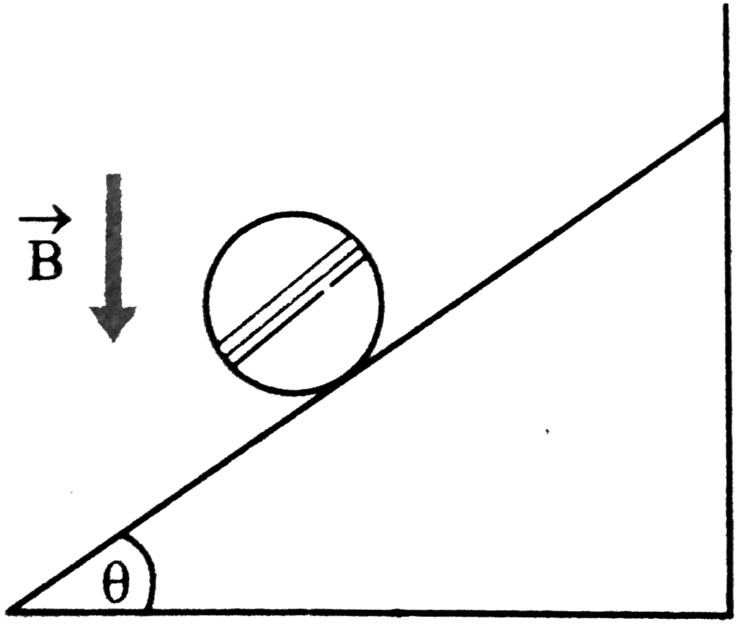
734. Figure shows a coil of single turn would on a sphere of radius R and mass m. The plane of the coil is parallel to the plane and lies in the equatorial plane of the sphere. What is the value of B if the sphere is in equilibrium when current in the coil is I?



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735. A magnetic dipole is free to rotate in a uniform magnetic field. For what orientation of the magnet with respect to the fiel (a) torque is maximum? (b) potential energy is maximum? (c) rate of change of torque with deflection is maximum?

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736. A length L of a wire carries a current I. Show that if the wire is formed into a circular coil, the maximum torque in a given magnetic fiel B, is developed when the coil has one turn only and the maximum torque has the value, $\tau_{\max} = L^2 IB / 4\pi$.

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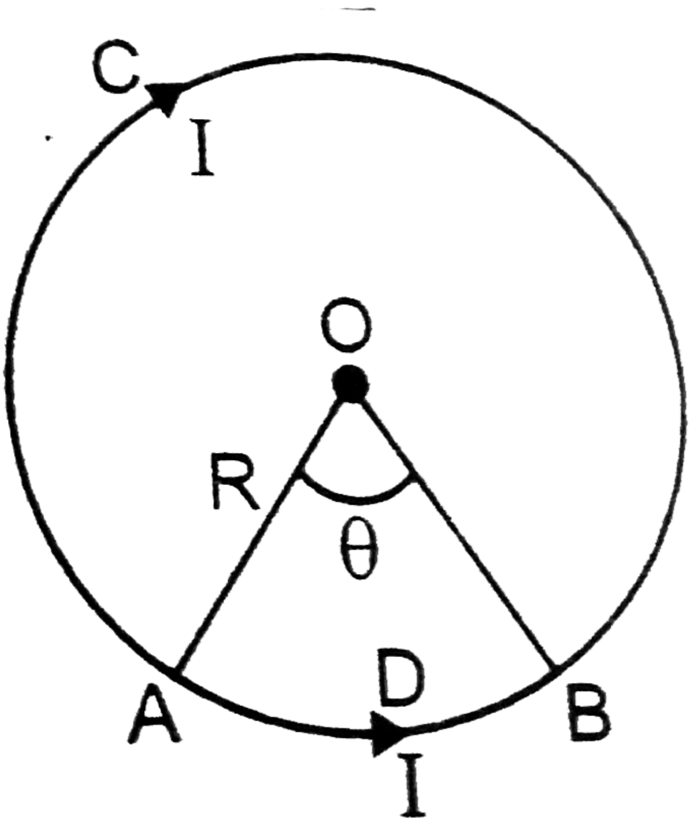
737. Equal current I flows in two segments of a circular loop in the direction shown in figure. Radius of loop is R. What is the magnitude of magnetic field induciton at the centre of the loop?



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738. Each atom of an iron bar $(5cm \times 1cm \times 1cm)$ has a magnetic moment $1 \cdot 8 \times 10^{-23} Am^2$.

(a) What will be the magnetic moment of the bar in the state of magnetic saturation.

(b) What will be the torque required to place this magnetised bar perpendicular to magnetic field of $15000 gauss$?

Density of iron $= 7 \cdot 8 \times 10^3 kg/m^3$, Atomic wt. of iron $= 56$, Avogadro's number $= 6 \cdot 023 \times 10^{23}/gm$ mole.

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739. Two magnets N_1S_1 and N_2S_2 having their magnetic moments as M and 3M respectively are joined at an angle of 60° as shown in figure. The combination is placed on a floating cork in water. Determine the angle θ which the weaker magnet makes with the magnetic meridian.

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740. Two circular coils C_1 and C_2 each of 100 turns are held in such a way that C_1 lies in vertical plane and the other C_2 in the horizontal plane, with their centres coinciding. The radii of the coils are $r_1 = 20cm$ and $r_2 = 30cm$. The directions of currents I_1 and I_2 passed through the two coils are such that earth's magnetic field at the common centre is neutralised completely. If $H = 27 \cdot 8Am^{-1}$ and angle of dip is $30°$. Calculate the values of I_1 and I_2.

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741. An iron sample having mass $8 \cdot 4kg$ is repeatedly taken over cycles of magnetisation and demagnetisation at a frequency of $50cps$. It is found that energy of $3 \cdot 2 \times 10^4 J$ is dissipated as heat in the sample in 30 minutes. If the density of iron is $7200kg/m^3$, calculate the value of energy dissipated per unit volume per cycle in the iron sample.

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742. Two linear parallel conductors carrying currents in the same direction attract each other and two linear parallel conductors carrying currents in opposite direction repel each other. The force acting per unit length due to currents I_1 and I_2 in two linear parallel conductors held distance r apart in vacuum in SI unit is

$$F = \frac{\mu_0}{4\pi} \frac{2I_1I_2}{r}$$

Read the above passage and answer the following questions:

(i) What is the basic reason for the force between two linear parallel conductors carrying currents?

(ii) Two straight wires A and B of lengths $2cm$ and $20cm$, carrying currents $2 \cdot 0A$ and $5 \cdot 0A$ respectively in opposite directions are lying parallel to each other $4 \cdot 0cm$ apart. The wire A is held near the middle of wire B. What is the force on $20cm$ long wire B?

(iii) What does this study imply in day to day life?

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743. When a galvanometer of resistance G is shunted with a low resistance S, then the effective resistance R_{eff} of galvanometer becomes

$$R_{eff} = \frac{GS}{G + S}$$

If current is passed through such a galvanometer, then the major amount of current flows through shunt and the rest through galvanometer, i.e., the current divides itself in the inverse ratio of resistance.

Read the above passage and answer the following questions:

(i) Why is the resistance of shunted galvanometer lower than that of shunt?

(ii) A galvanometer of resistance 30Ω is shunted by a resistance of

3Ω. What fraction of the main current passes (i) through the galvanometer and (ii) through the shunt?

(iii) What are the basic values you learn from the above study?

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744. A rectangular coil of n turns each of area A, carrying current I, when suspended in a uniform magnetic field B, experiences a torque

$\tau = nIBA\sin\theta$

where θ is the angle with a normal drawn on the plane of coil makes with the direction of magnetic field. This torque tends to rotate the coil and bring it in equilibrium position. In stable equilibrium state, the resultant force on the coil is zero. The torque on coil is also zero and the coil has minimum potential energy.

Read the above passage and answer the following questions:

(i) In which position, a current carrying coil suspended in a uniform magnetic field experiences (a) minimum torque and (b) maximum torque?

(ii) A circular coil of 200 turns, radius $5cm$ carries a current of $2 \cdot 0A$. It is suspended vertically in a uniform horizontal magnetic field of $0 \cdot 20T$, with the plane of the coil making an angle of 60° with the field lines. Calculate the magnitude of the torque that must be applied on it to prevent it from turning.

(iii) What is the basic value displayed by the above study?

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745. A physics teacher explains Gauss's theorem in electrostatics and Gauss's theorem in magnetism to his students in a class. He tells them that total normal electric flux over a closed surface in vacuum is $\phi_e = \dfrac{Q}{\in_0}$, where Q is algebraic sum of charges inside the surface. Further, total normal magnetic flux over a closed surface in vacuum is always zero. The teacher emphasises that this is because in magnetism, poles always exist in unlike pairs of equal strengh, i.e., isolated magnetic poles called monopoles do not exist.

Read the above passage and answer the following questions:

(i) What are the implications of Gauss's theorem in magnetism in day to day life?

(ii) Two magnetic dipoles of moments $5Am^2$ and $3Am^2$ oriented along opposite directions are enclosed in a surface. What is total normal magnetic flux over this surface?

(iii) Two point charges $+4q$ and -q are enclosed in a surface in vacuum, and third charge $5q$ lies outside the surface. What is total normal electric flux over the surface?

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746. Two charged particles traverse identical helical paths in a completely opposite sense in a uniform magnetic field $\vec{B} = B_0\hat{K}$

A. They have equal z-components of momenta

B. They must have equal charges

C. They necessarily represent a particle-antiparticle pair

D. The charge to mass ratio satisfy:

$$\left(\frac{e}{m}\right)_1 + \left(\frac{e}{m}\right)_2 = 0$$

Answer: D

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747. Biot-Savart law indicates that the moving electrons (velocity $\vec{v}$) produce a magnetic field $\vec{B}$ such that

A. $\vec{B} \perp \vec{v}$

B. $\vec{B} \mid \mid \vec{v}$

C. it obeys inverse cube law

D. it is along the line joining the electron and point of observation

Answer: A

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748. A current carrying circular loop of radius R is placed in the x-y plane with centre at the origin. Half of the loop with $x > 0$ is now bent so that it now lies in the y-z plane.

A. The magnitude of magnetic moment now diminishes

B. The magnetic moment does not change

C. The magnitude of $\vec{B}$ at $(0, 0, z), z > \ > R$ increases

D. The magnitude of $\vec{B}$ at $(0, 0, z), z > \ > R$ is unchanged

Answer: A

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749. An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true?

A. The electron will be accelerated along the axis

B. The electron path will be circular about the axis

C. The electron will experience a force at 45° to the axis and hence execute a helical path

D. The electron will continue to move with uniform velocity along the axis of the solenoid.

Answer: D

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750. In a cyclotron, a charged particle

A. undergoes acceleration all the time.

B. speeds up between the dees because of the magnetic field

C. speeds up in a dee

D. slows down with a dee and speeds up between dees

Answer: A

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751. A ciruclar current loop of magnetic moment M is in an arbitrary orientation in an external magnetic field $\vec{B}$. The work done to rotate the loop by 30° about an axis perpendicular to its plane is

A. MB

B. $\sqrt{3}\frac{MB}{2}$

C. $\frac{MB}{2}$

D. zero

Answer: D

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752. The gyro-magnetic ratio of an electron in an H-atom, according to Bohr model, is

A. independent of which orbit it is in

B. negative

C. positive

D. increases with the quantum number n

Answer: A::B

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753. Consider a wire carrying a steady current, I placed in a uniform magnetic field $\vec{B}$ perpendicular to its length. Consider the charges inside the wire. It is known that magnetic forces do not work. This implies that

A. motion of charges inside the conductor is unaffected by $\vec{B}$ since they do not absorb

B. Some charges inside the wire move to the surface as a result of $\vec{B}$

C. if the wire moves under the influence of $\vec{B}$, no work is done by the force

D. if the wire moves under the influence of $\vec{B}$, no work is done by the magnetic force on the ions, assumed fixed within the wire

Answer: B::D

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754. Two identical current carrying coaxial loops, carry current I in an opposite sense. A simple amperian loop passes through both of them once. Calling the loop as C,

A. $\oint \vec{B}.\,d\vec{l} = \pm 2\mu_0 I$

B. the value of $\oint_C \vec{B}.\,d\vec{l}$ is independent of sense of C

C. there may be a point on C where $\vec{B}$ and $d\vec{l}$ are perpendicular

D. $\vec{B}$ vanishes everywhere on C

Answer: B::C

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755. A cubical region of space is filled with some uniform electric and magnetic fields. An electron enters the cube across one of its faces with velocity $\vec{v}$ and a positron enters via opposite face with velocity - $\vec{v}$. At this instant,

A. the electric forces on both the particles cause identical accelerations

B. the magnetic forces on both the particles cause equal acceleration

C. both particles gain or loose energy at the same rate

D. the motion of the centre of mass (CM) is determined by $\vec{B}$ alone

Answer: B::C::D

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756. A charged particle would continue to move with a constant velocity in a region wherein,

A. $\vec{E} = 0, \vec{B} \neq 0$

B. $\vec{E} \neq 0, \vec{B} \neq 0$

C. $\vec{E} \neq 0, \vec{B} = 0$

D. $\vec{E} = 0, \vec{B} = 0$

Answer: A::B::D

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757. A toroid of n turns, mean radius R and cross-sectional radius a carries current I. It is placed on a horizontal table taken as x-y plane. Its magnetic moment $\vec{M}$

A. is non-zero and points in the z-direction by symmetry

B. points along the axis of the toroid $\left(\vec{M} = M\hat{\phi}\right)$

C. is zero, otherwise there would be a field falling as $\frac{1}{r^3}$ at large distance outside the toroid

D. is pointing radially outwards.

Answer: C

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758. The magnetic field of Earth can be modelled by that of a point dipole placed at the centre of the Earth. The dipole axis makes an angle of $11 \cdot 3^\circ$ with the axis of Earth. At Mumbai, declination is nearly zero. Then,

A. the declination varies between $11 \cdot 3^\circ W$ to $11 \cdot 3^\circ E$

B. the least declination is 0°

C. the plane defined by dipole axis and Earth axis passes through Greenwich

D. declination averaged over Earth must be always negative

Answer: A

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759. In a permanent magnet at room temperature.

A. magnetic moment of each molecule is zero

B. the individual molecules have non-zero magnetic moment which are all perfectly aligned

C. domains are partially aligned

D. domains are all perfectly aligned

Answer: C

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760. Consider the two idealized systems: (i) a parallel plate capacitor with large plates and small separation and (ii) a long solenoid of length $L > > R$, radius of cross-section. In (i) $\vec{E}$ is ideally treated as a constant between plates and zero outside. In

(ii) magnetic field is constant inside the solenoid and zero outside.

These idealised assumptions, however, contradict fundamental law as below:

A. case (i) contradicts Gauss's law for electrostatic fields

B. case (ii) contradicts Gauss's law for magnetic fields.

C. case (i) agrees with $\oint \vec{E}.d\vec{l} = 0$

D. case (i) contradicts $\oint \vec{H}.d\vec{l} = l_m$

Answer: B

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761. A paramagnetic sample shows a net magnetisation of $8Am^{-1}$ when placed in an external magnetic field of $0 \cdot 6T$ at a temperature of $4K$. When the same sample is placed in an external magnetic field of $0 \cdot 2T$ at a temperature of $16K$, the magnetisation will be

A. $\frac{32}{3} Am^{-1}$

B. $\frac{2}{3} Am^{-1}$

C. $6Am^{-1}$

D. $2 \cdot 4Am^{-1}$

Answer: B

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762. S is the surface of a lump of magnetic material.

A. Lines of $\vec{B}$ are necessarily continuous across S

B. Some lines of $\vec{B}$ must be discontinuous across s

C. Lines of $\vec{H}$ are necessarily continuous across S

D. Lines of $\vec{H}$ can not be continuous across S

Answer: A::D

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763. The primary origin(s) of magnetism lies in

A. atomic currents

B. Pauli exclusion principle

C. polar nature of molecules

D. intrinsic spin of electron

Answer: A::D

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764. A long solenoid has 1000 turns per metre and carries a current of $1A$. It has a soft iron core of $\mu_r = 1000$. The core is heated beyond the Curie temperature, T_c.

A. The $\vec{H}$ field in the solenoid is (nearly) unchanged but the $\vec{B}$ field decreases drastically

B. The $\vec{H}$ and $\vec{B}$ fields in the solenoid are nearly unchanged

C. The magnetisation in the core reverse direction

D. The magnetisation in the core diminishes by a factor of about 10^8

Answer: A::D

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765. Essential difference between electrosatic shielding by a conducting shall and magnetostatic shielding is due to

A. electrostatic field lines can end on charges and conductors have free charges

B. lines of $\vec{B}$ can also end but conductors can not end them

C. lines of $\vec{B}$ can not end on any material and perfect shielding is not possible.

D. shells of high permeability materials can be used to divert lines of $\vec{B}$ from the interior region

Answer: A::C::D

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766. Let the magnetic field on earth be modelled by that of a point magnetic dipole at the centre of earth. The angle of dip at a point on the geographical equator

A. is always zero

B. can be zero at specific points

C. can be positive or negative

D. is bounded

Answer: B::C::D

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Conceptual Problems (d)

1. Why do we prefer to use the alloy alinco for making permanent magnets?

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2. What is a non magnetic material?

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Very Short Answer Questions (a)

1. What is the unit of magnetic field strength in cgs system and SI? State the relation between them.

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2. State any rule which relates the direction of electric current and the direction of the accompanying mangnetic field due to circular coil carrying current.

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Short Answer Questions (b)

1. What is the main function of a soft iron core used in a moving coil galvanometer?

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NCERT Exemplar Problems (Chapter 5 Short Answer Questions)

1. use (i) the Ampere's law for H and (ii) continuity of lines of B, to conclued that inside a bar magnet, (a) lines of H run from the N pole to S pole, while (b) lines of B must run from the S pole to N pole.

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Value Based Questions

1. A physics teacher tells his students in class that in paramagnetic materials, every atom has some permanent magnetic dipole moment. In the absence of an external magnetic fund, the atomic dipoles are randomly oriented so that average magnetic moment per unit volume of the material is zero. Therefore, in the absence of an external magnetic field, a paramagnetic material does not behave as a magnet. When an external magnetic field is applied, the torque developed tries to align the atomic magnetic dipoles in the direction of the field. That is why the specimen gets magnetized weakly in the direction of the field.

Read the above passage and answer the following questions:

(i) Name any three paramagnetic materials.

(ii) Name any two ferromagnetic materials. How is their behavior different from that of paramagnetic materials?

(iii) The teacher asks the students how true is the famous saying: 'Spare the rod and spoil the child,' comment.

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2. Saniya and Priya are friends. Both of them know that a small compass needle points always along north south direction. One day Saniya is plotting field due to a bar magnet in the laboratory. She discovers a point where compass needle does not point along N-S. Rather, it sets itself in any arbitrary direction. Saniya thinks first that compass needle has become faulty. Priya then explains to her the real situation.

Read the above passage and answer the following questions:

(i) How did Priya justify the situation?

(ii) If a bar magnet is placed along N-S direction with its north pole pointing north, what is the position of neutral points?

(iii) If a bar magnet is placed along N-S direction with its north pole pointing south, what is the position of neutral points?

(iv) What values of life do you learn from this piece of knowledge?

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Exercise

1. The magnetic field at a perpendicular distance of $2cm$ from an infinite straight current carrying conductor is $2 \times 10^{-6}T$. The current in the wire is

A. $0 \cdot 1A$

B. $0 \cdot 2A$

C. $0 \cdot 4A$

D. $0 \cdot 8A$

Answer: B

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2. A positive charge is moving towards an observer. The direction of magnetic induction lines is

A. clockwise

B. anticlockwise

C. right

D. left

Answer: B

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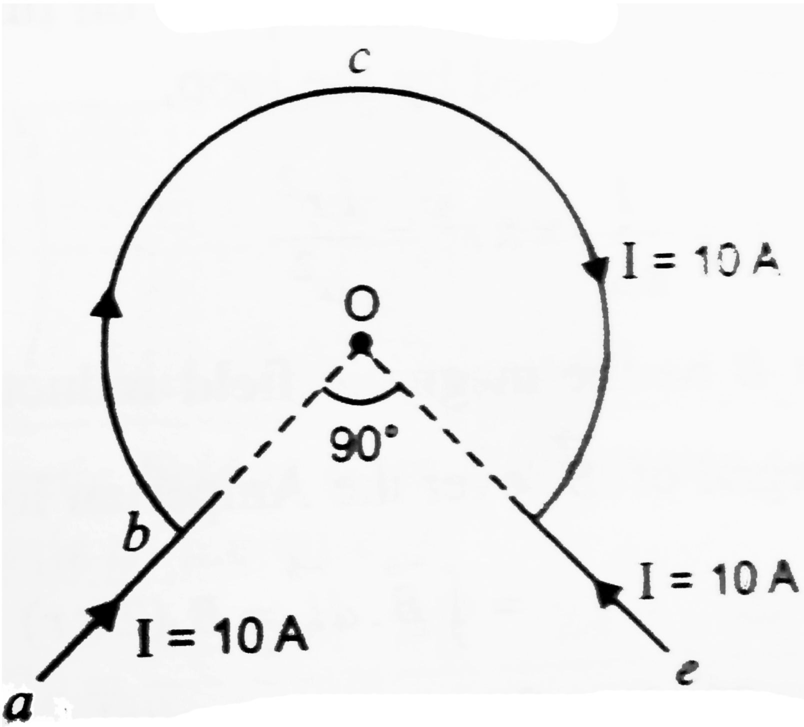
3. The wire shown in figure carries a current of $10A$. Determine the magnitude of the magnetic field at the centre O.

Given radius of the bent coil is $3cm$.



A. $1 \cdot 57 \times 10^{-3} T$

B. $1 \cdot 57 \times 10^{-4} T$

C. $3 \cdot 14 \times 10^{-3} T$

D. $3 \cdot 14 \times 10^{-4} T$

Answer: B

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

A. only outside the wire

B. only inside the wire

C. both inside and outside the wire

D. neither inside nor outside the wire

Answer: A

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5. A current carrying wire produces in the neighbourhood

A. Only electric field

B. Only magnetic field

C. Both electric field and magnetic field

D. None of the above

Answer: B

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6. A circular coil of n turns and radius r carries a current I. The magnetic field at the center is

A. $\frac{\mu_0 nI}{r}$

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

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

D. $\frac{\mu_0 nI}{4r}$

Answer: B

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7. A thin ring of radius R metre has charge q coulomb uniformly spread on it. The ring rotates about its axis with a constant frequency of f revolution/s. The value of magnetic induction in Wbm^{-2} at the centre of the ring is

A. $\frac{\mu_0 qf}{2\pi R}$

B. $\frac{\mu_0 q}{2\pi fR}$

C. $\frac{\mu_0 q}{2fR}$

D. $\frac{\mu_0 qf}{2R}$

Answer: D

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8. A small coil of N turns has area A and a current I flows through it. The magnetic dipole moment of this coil will be

A. $5Am^2$

B. $15Am^2$

C. $30Am^2$

D. $45Am^2$

Answer: D

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9. A circular coil carrying current behaves as a

A. bar magnet

B. horse shoe magnet

C. magnetic shell

D. solenoid

Answer: C

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10. A long solenoid has n turns per metre and current IA is flowing through it. The magnetic field induciton at the ends of the solenoid is

A. zero

B. $\mu_0 nI/2$

C. $\mu_0 nI$

D. $2\mu_0 NI$

Answer: B

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11. Two particles A and B having equal charges $+6C$, after being accelerated through the same potential differences, enter a region of uniform magnetic field and describe circular paths of radii $2cm$ and $3cm$ respectively. The ratio of mass of A to that of B is

A. $\frac{4}{9}$

B. $\frac{9}{5}$

C. $\frac{9}{4}$

D. $\frac{1}{3}$

Answer: A

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12. An electron is moving at a speed of $100ms^{-1}$ along the x-axis through uniform electric and magnetic fields. The magnetic field is directed along z-axis and has magnitude $5 \cdot 0T$. In unit vector notation, what is the electric field?

A. $(100V/m)\hat{j}$

B. $(-100V/m)\hat{k}$

C. $(-500V/m)\hat{k}$

D. $(500V/m)\hat{j}$

Answer: D

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13. The force between two parallel current carrying wires is independent of

A. their distance of separation

B. the length of the wires

C. the radii of the wires

D. the medium in which they are placed

Answer: C

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14. A straight conductor is placed along the axis of a circular coil perpendicular to the plane of the coil. Then electric current is passed through both,

A. only straight conductor experiences force

B. only coil experiences force

C. both experience force

D. none experiences force

Answer: D

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15. The force experienced by a wire of length $10cm$ kept at an angle of 30° to a uniform magnetic field of $0 \cdot 5T$ and carrying a current of $6A$ is

A. $0 \cdot 5A$

B. $1N$

C. $0 \cdot 15N$

D. $0 \cdot 2N$

Answer: C

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16. A rectangular coil of turns 500 and area $2cm \times 1cm$ carries $100mA$ current. It is suspended in a uniform magnetic field of $10^{-3}T$, so that its plane makes an angle 60° with it. The torque on the coil in N-m is

A. 5×10^{-2}

B. 5×10^{-3}

C. 5×10^{-4}

D. 5×10^{-6}

Answer: D

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17. To protect galvanometer from possible damages due to large current, which of the following is connected to its coil:

A. Low resistance wire in series

B. Low resistance wire in parallel

C. High resistance wire is series

D. High resistance wire in parallel

Answer: B

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18. To convert galvanometer into ammeter which one of the following is connected with the coil:

A. High resistance wire in series

B. Low resistance wire in parallel

C. High resistance wire in parallel

D. Low resistance wire in series

Answer: B

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19. An ammeter reads upto 1 ampere. Its internal resistance is 0.81 ohm. To increase the range to 10 A the value of the required shunt is

A. $0 \cdot 03\Omega$

B. $0 \cdot 3\Omega$

C. $0 \cdot 9\Omega$

D. $0 \cdot 09\Omega$

Answer: D

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20. A galvanometer has a resistance of 30Ω and a current of $2 \cdot 0mA$ gives full scale deflection. How will you convert this galvanometer into a voltmeter of $0 \cdot 2$ volt range?

A. 700Ω resistance should be connected parallel to the galvanometer

B. 70Ω resistance should be connected parallel to the galvanometer

C. 700Ω resistance should be connected in series with the galvanometer

D. 70Ω resistance should be used in series with the galvanometer

Answer: D

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21. Choose the correct statement.

A. Current sensitivity of a moving coil galvanometer is inversely proportional to magnetic field induction

B. To convert a galvanometer into an ammeter, a high resistance is connected in series

C. To convert a galvanometer into a voltmeter, a low resistance is connected in parallel

D. Voltage sensitivity of a moving coil galvanometer is directly proportional to the magnetic field induction.

Answer: D

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22. The ratio of the shunt resistance and the resistance of a galvanometer is $1 \cdot 499$. If the full scale deflection current of the galvanomter is $2mA$, the range of ammeter is

A. $1A$

B. $2A$

C. $3A$

D. $4A$

Answer: A

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23. When distance between two given magnetic poles is halved, force between them becoems k times, where $k =$

A. 1

B. 2

C. 4

D. $1/4$

Answer: D

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24. What is not true about poles of a magnet?

A. poles exist always in pairs

B. poles of a magnet are always unlike

C. poles of a magnet are of equal strength

D. poles are situated a little outwards from the geometrical ends of magnet

Answer: D

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25. SI unit of magnetic pole strength is

A. Ampere $metre^{-1}$

B. Ampere $metre^{-2}$

C. Ampere meter

D. Ampere $metre^{-2}$

Answer: C

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26. Magnetic moment of a current loop becomes k times when diameter of loop is made twice and number of turns is made three fold where, $k =$

A. 2

B. 3

C. 6

D. 12

Answer: D

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27. Magnetic field strength due to a bar magnet at a point distant d from the center of magnet

A. $1/d$

B. d

C. d^3

D. $1/d^3$

Answer: D

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28. Torque acting on a magnet held at angle θ with a magnetic field is maximum, where $\theta =$

A. 0°

B. 90°

C. 360°

D. 90°

Answer: D

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29. In the potential energy of magnetic dipole is zero when $\theta =$

A. 0°

B. 90°

C. 180°

D. 360°

Answer: B

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30. The small angle between magnetic axis and geographical axis at a place is called

A. magnetic inclination

B. magnetic dip

C. magnetic declination

D. none of the above

Answer: C

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31. Horizontal component of earth at a place is $3 \cdot 2 \times 10^{-5} T$, and angle of dip is 60°. The resultant intensity of earth's field at the place is

A. $3 \cdot 2 \times 10^{-5} T$

B. $6 \cdot 4 \times 10^{-5} T$

C. $1 \cdot 6 \times 10^{-5} T$

D. $12 \cdot 8 \times 10^{-5} T$

Answer: B

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32. The correct value of Bohr magneton is

A. $9.27 \times 10^{-24} Am^2$

B. $9.27 \times 10^{24} Am^2$

C. $9.27 \times 10^{-24} Am^{-2}$

D. $9.27 \times 10^{24} Am^{-2}$

Answer: A

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33. Choose the diamagnetic material out of the following

A. gold

B. aluminium

C. iron

D. cobalt

Answer: A

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34. For a paramagnetic substance

A. $\mu_r = 1$

B. $\mu_r = 0$

C. $\mu_r > 1$

D. $\mu_r = infinity$

Answer: C

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35. For a paramagnetic substance

A. $\chi_m \propto T$

B. $\chi_m = T^2$

C. $\chi_m = T^0$

D. $\chi_m = \propto T^{-1}$

Answer: D

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36. Curie temperature is the temperature above which

A. a ferromagnetic material becomes paramagnetic

B. a paramagnetic material becomes diamagnetic

C. a paramagnetic material becomes ferromagnetic

D. a paramagnetic material becomes ferromagnetic

Answer: A

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37. Biot Savart's law deals with the magnetic field induction at a point due to a................... .

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38. The direction of magnetic field lines due to straight conductor carrying current is given by.................... .

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39. If current through a circular coil flows in clockwise direction, then the direction of magnetic field at the centre of the circular coil is..................to the plane of the coil, directed................ .

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40. The magnetic dipole moment of a current loop, carrying current I, having n turns, each of radius r is...................... .

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41. The magnetic field induction is.................for a point on the surface of solid cylinder carrying current and is.....................for a point on the axis of the cylinder.

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42. Ampere's law is applicable for....................current distribution whereas the Biot Savart's law is applicable for....................current distribution.

Watch Video Solution

43. If a charged particle is describing a circular path of radius r under the effect of perpendicular electric field, (i.e., motion of an electron around the nucleus of an atom) the force on the charged particle is.................proportional to the ....of radius of the circular path.

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44. When a charged particle is projected perpendicular to the magnetic field, the force acting on the charged particle is...............of the radius of circular path but................the speed of the charged particle.

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45. The force on a wire carrying of any shape in a uniform field is................of its shape but.........................on the vector length joining the beginning and ending of the current carrying wire.

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46. The two linear parallel conductors carrying currents in the opposite direction.....................each other.

Watch Video Solution

47. A linear conductor carrying if placed parallel to the direction of magnetic field, it experiences ....force.

Watch Video Solution

48. When a coil carrying current is set with its plane perpendicular to the direction of magnetic field, then torque on the coil is................ .

Watch Video Solution

49. The magnetic field lines of a magnet form...................loops unlike..................field lines.

Watch Video Solution

50. According to Gauss's law for magnetism, ...through any closed surface is............................ .

Watch Video Solution

51. Magnetic inclination at a place is the angle which the......................makes with................in................ .

Watch Video Solution

52. Isogonic lines are the lines joining places of....................... .

Watch Video Solution

53. In the northern hemisphere, magnetic lines of force due to earth's field point ....

Watch Video Solution

54. At a particular place, horizontal and vertical components of earth's magnetic field are equal. The angle of dip at that place is............... .

Watch Video Solution

55. Bohr magneton is the .... magnetic dipole moment associated with .... due to orbital motion of .... in the stationary orbit of the atom.

Watch Video Solution

56. Relative magnetic permeability of a material is defined as the ratio of ....to..................of.............. .

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57. Magnetic field strength, ..., flux ....represents the same quantity.

Watch Video Solution

58. SI units of magnetic permeability are ...., ..., ...

Watch Video Solution

59. Magnetic moment per unit volume of the material is called .... of the material.

Watch Video Solution

60. Intensity of magnetisation of a magnetic material is defined as ....per unit................of the material.

Watch Video Solution

61. Units of magnetising intensity and intensity of magnetisation are...................., i.e., ...

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62. Individual atoms/molecules/ions of a diamagnetic substance............any net..................on their own.

Watch Video Solution

63. Superconductors are the most exotic..................materials. Infact, ...conductivity and perfect.................go together.

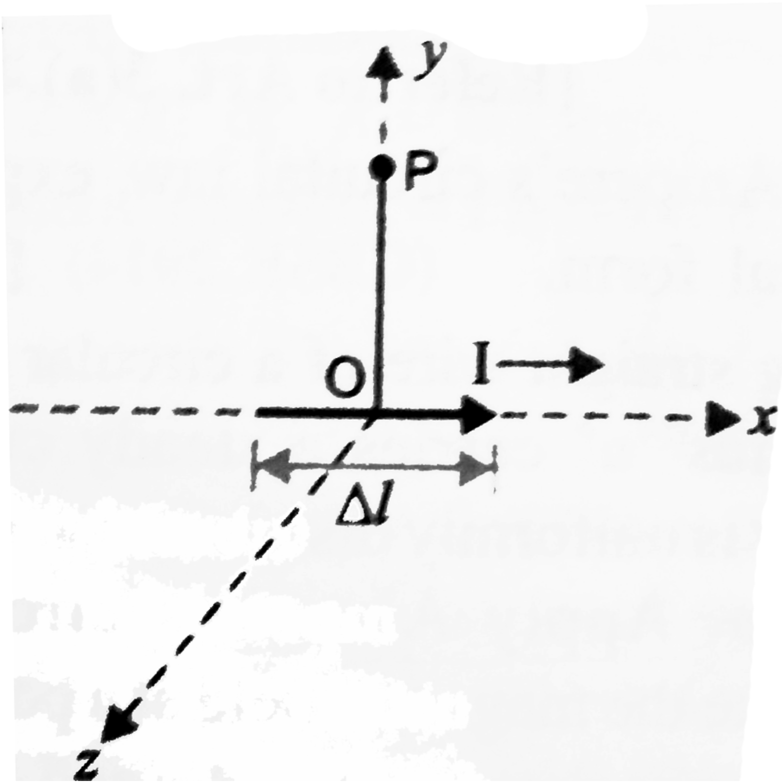
Watch Video Solution

64. According to Curie law in magnetism, ...of a magnetic material varies................as the ....of the material.

Watch Video Solution

65. An element $\Delta \vec{l} = \Delta x\hat{i}$ is placed at the origin as shown in figure and carries a current $I = 2A$. Find out the magnetic field at a point P on the y-axis at a distance of $1 \cdot 0m$ due to the element $\Delta x = 1cm$

. Give also the direction of the field produced.



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66. A wire placed along north-south direction carries a current of $5A$ from south to north. Find the magnetic field due to a $1cm$ piece of wire at a point $200cm$ north east from the piece.

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67. A current of $10A$ is flowing east to west in a long wire kept in the east-west direction. Find magnetic field in a horizontal plane at a distance of (i) $10cm$. North (ii) $20cm$ south from the wire, and in a vertical plane at a distance of (iii) $40cm$ downwards, (iv) $50cm$ upwards.

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68. Calculate the magnetic field induction at the center of the coil in the form of a square of side $10cm$, carrying a current of $10A$.

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69. What current must flow in an infinitely long straight wire to produce a magnetic field of $4 \times 10^5 T$ at $8cm$ away from the wire?

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70. Two long parallel wires are placed at a distance of $12cm$ from each other in air. Each wire has a current of $3A$. Calculate the magnetic field at a point mid way between them when the currents in them are : (i) in the same direction and (ii) in opposite direction.

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71. A long straight wire carrying a current of $25A$ is placed in an external uniform magnetic field $3 \cdot 0 \times 10^{-4}T$ parallel to the current. Find the magnitude of the resultant magnetic field at a point $1 \cdot 5cm$ away from the wire.

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72. Find the magnetic field B at the center of a rectangular loop of length l and width b, carrying a current i.

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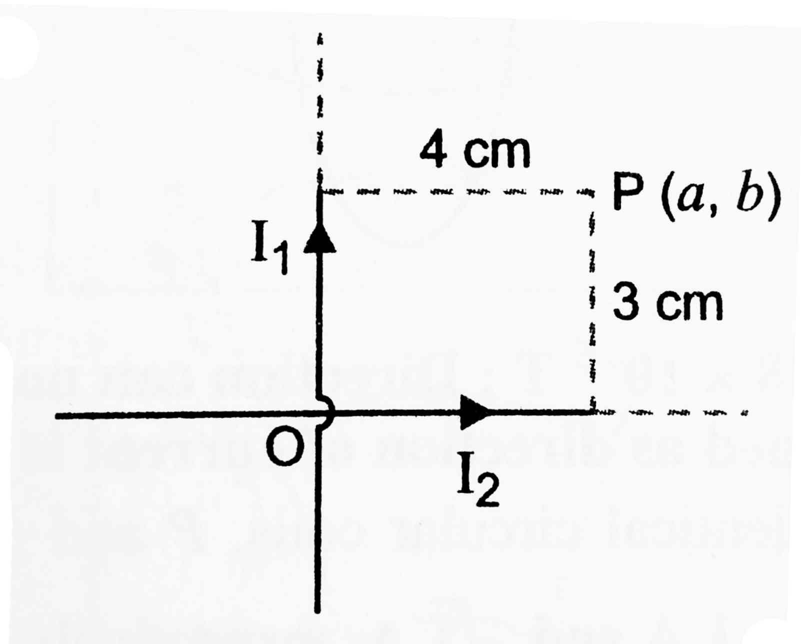
73. Two insulating infinite long conductors carrying currents $I_1(=2A)$ and $I_2(=4A)$ lie mutually perpendicular to each other in the same plane, as shown in figure. Find the magnetic field at the point P(a,b), where $a = 4cm, , b = 3cm$.



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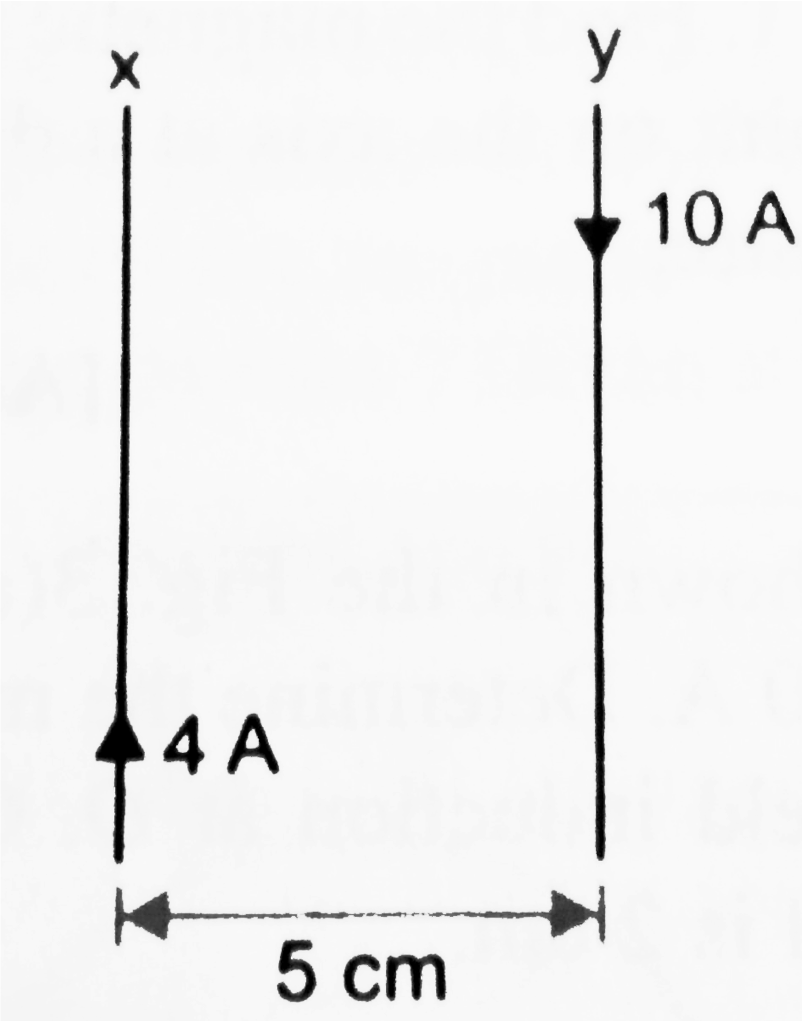
74. Figure shows two long parallel straight wires distance 5cm apart carrying currents $4A$ and $10A$ in opposite directions. Find the position of a point where the resultant magnetic field due to current in two wires in zero.



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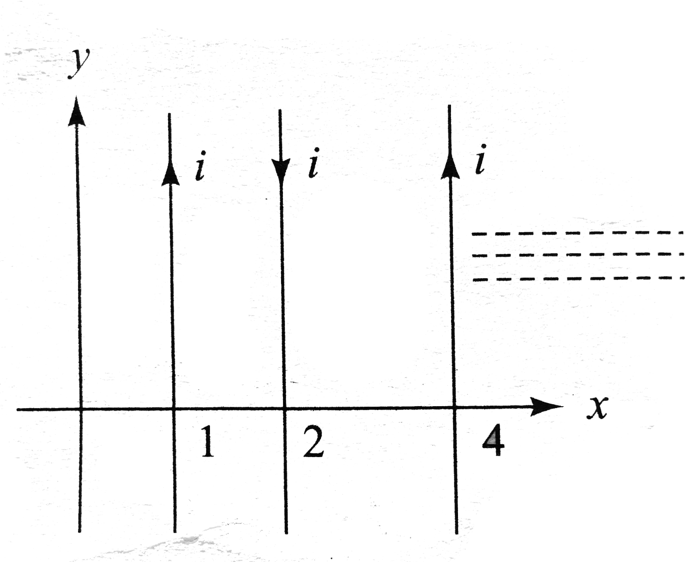
75. Equal currents $i = 1$ A are flowing through the wires parallel to y-axis located at $x = +1m, x = +2m, x = +4m$ and so on...., etc. but in opposite directions as shown in Fig The magnetic field (in tesla) at origin would be



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76. A straight wire of length $\pi/2$ meter, is bent into a circular shape. If the wire were to carry a current of $5A$, calculate the magnetic field, due to it, before bending, at a point distance $0 \cdot 01$

times the radius of the circle formed from it. Also calculate the magnetic field, at the centre of the circular loop formed, for the same value of current.

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77. The electron of hydrogen atom moves along a circular path of radius $0 \cdot 5 \times 10^{-10} m$ (i) with a speed of $4 \cdot 0 \times 10^{6} ms^{-1}$. (ii) with a frequency $6 \cdot 8 \times 10^{15} Hz$. Calculate the magnetic field produced at the centre of the circular path.

$\left(e = 1 \cdot 6 \times 10^{-19} C\right)$.

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78. Calculate the magnetic field due to a circular coil of 250 turns and of diameter $0 \cdot 1m$, carrying a current of $7A$ (i) at the center of the coil (ii) at a point on the axis of the coil at a distance $0 \cdot 12m$ from the center of the coil.

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79. The magnetic field due to a current-carrying circular loop of radius $10cm$ at its centre is $0 \cdot 60 \times 10^{-4}T$. Find the magnetic field due to this loop at a point on the axis at a distance of $4cm$ from the centre.

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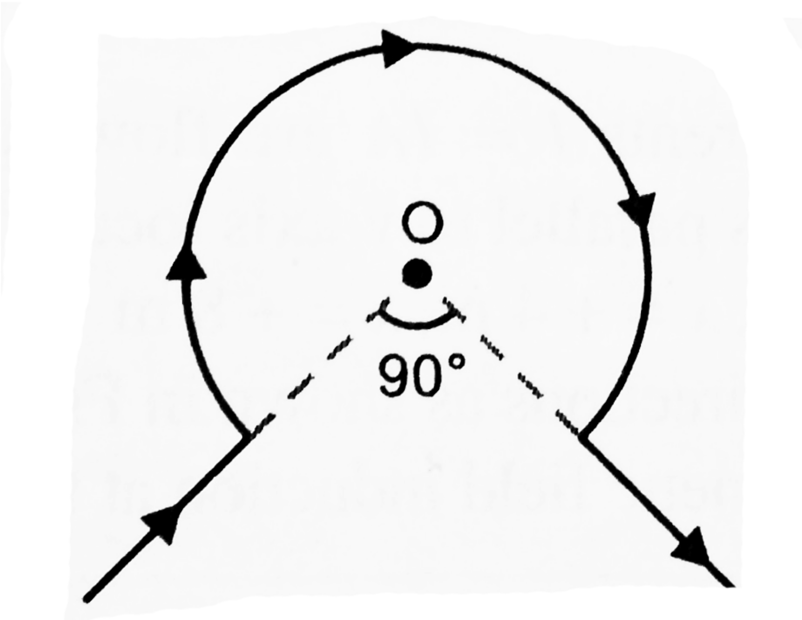
80. The wire shown in the figure, carries a current of $60A$. Determine the magnitude of the magnetic field induction at O.

Given radius of the bent coil is $2cm$.



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81. An alpha particle moves along a circular path of radius $2Å$ with a uniform speed of $2 \times 10^6 ms^{-1}$. Calculate the magnetic field set up at the center of circular path.

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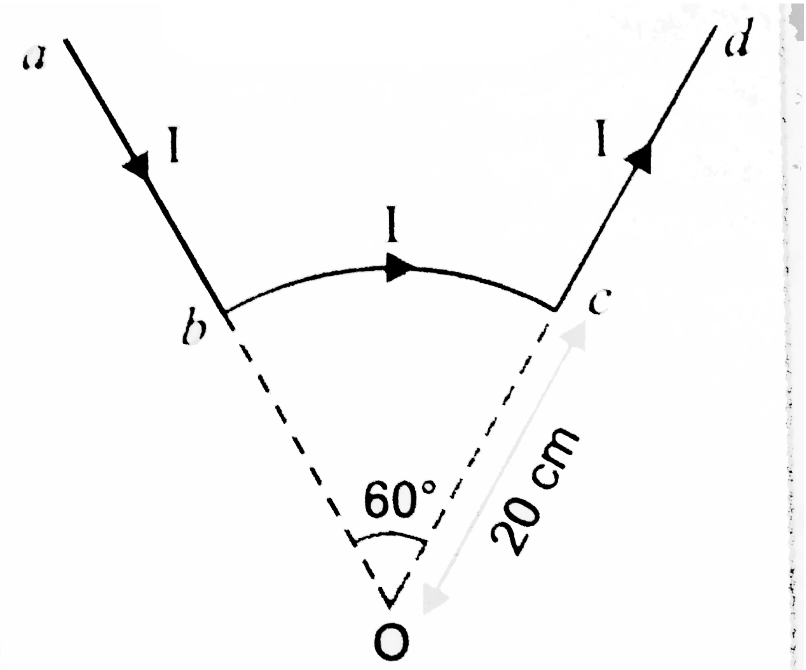
82. A circular segment of radius $20cm$ subtends an angle of 60° at its centre. Figure A current of $10A$ is flowing through it. Find the magnitude and direction of the magnetic field produced at the centre.



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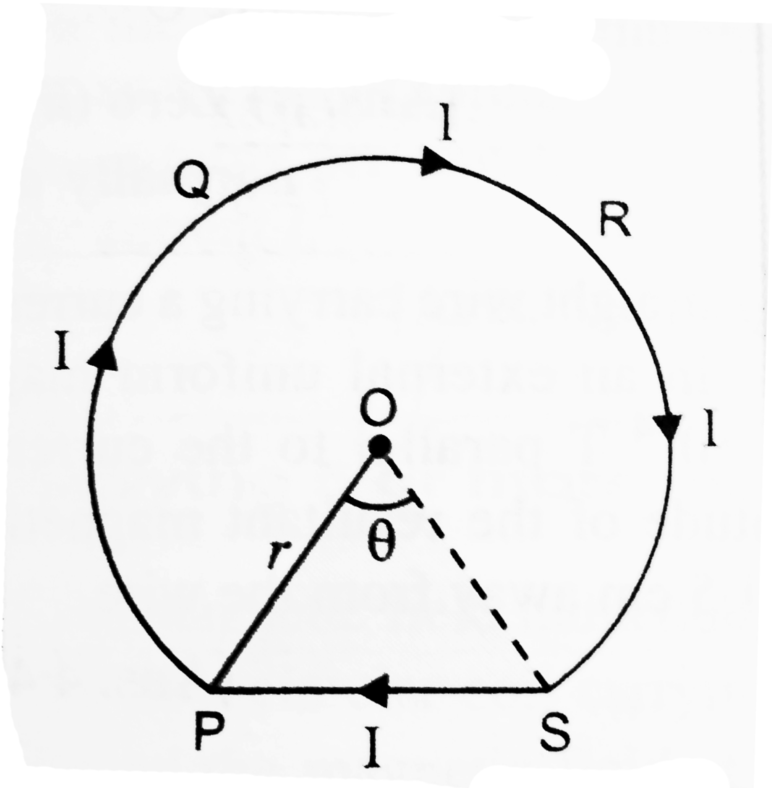
83. A current $I(=4A)$ flows along a thin wire PQRS shaped as shown in figure. The radius of the curved part of the wire is $10 \cdot 0cm$. The angle $\theta = 90^{\circ}$. Find the magnitude of the total magnetic field at the point O.



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84. Two identical coils each of radius $10 cm$ and having number of turns 100 are lying in perpendicular planes, such that they have common centre. Find the resultant magnetic field at the centre of the coils if they carry currents $3A$ and $3\sqrt{3}A$ respectively.

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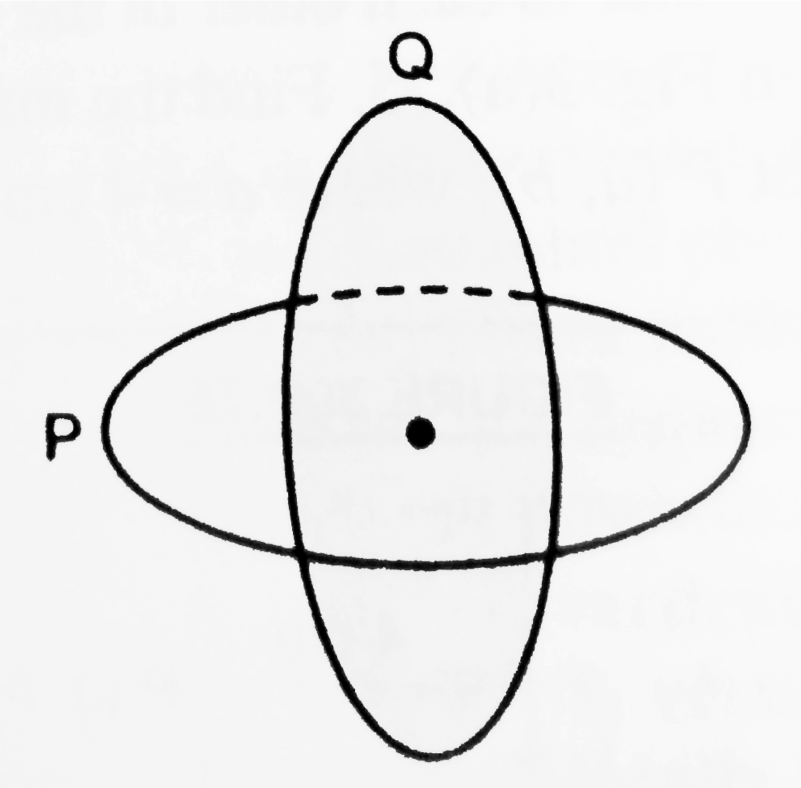
85. Two identical loops P and Q each of radius $5 cm$ are lying in perpendicular planes such that they have a common centre as shown in the figure. Find the magnitude and direction of the net field at the common centre of the two coils, if they carry currents equal to $3A$ and $4A$ respectively.



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86. Two identical circular coils, P and Q, carrying currents $1A$ and $\sqrt{3}A$ respectively, are placed concentrically and perpendicular to each other lying in the XY and YZ plane. Find the magnitude and direction of the net magnetic field at the centre of the coils.

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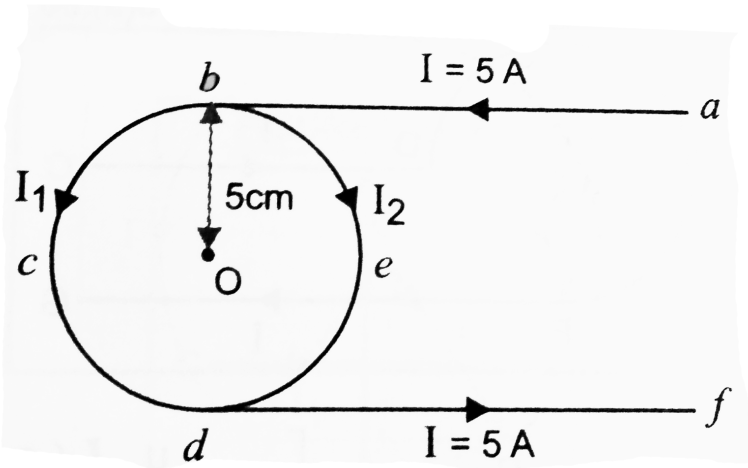
87. In the net work shown in figure,find the magnetic field at the centre O of the coil.



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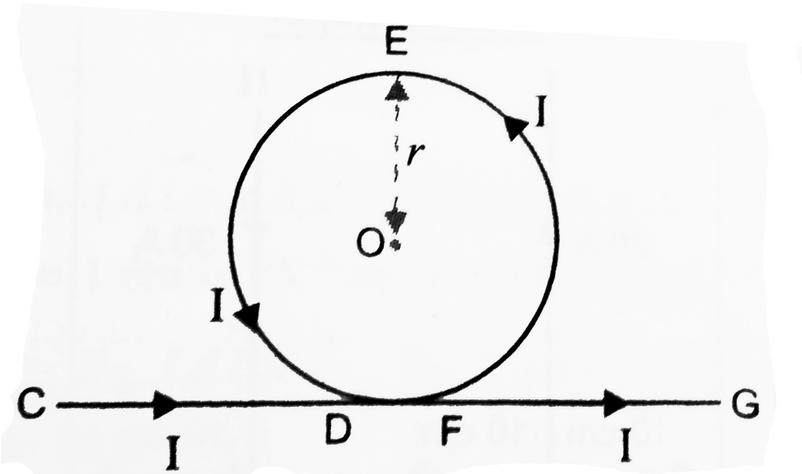
88. An electric current of I ampere is flowing in a long conductor CG as shown in figure. Find the magnitude and direction of magnetic induction at the centre O of circular part.



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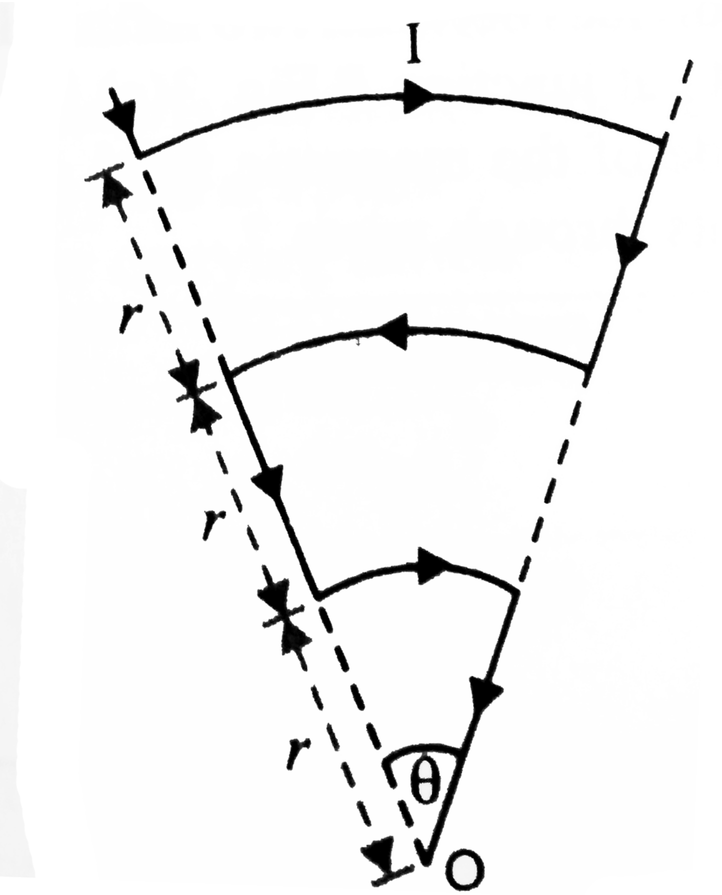
89. A conductor carrying current I is of the type as shown in figure.

Find the magnetic field induction at the common centre O of all the three arcs.



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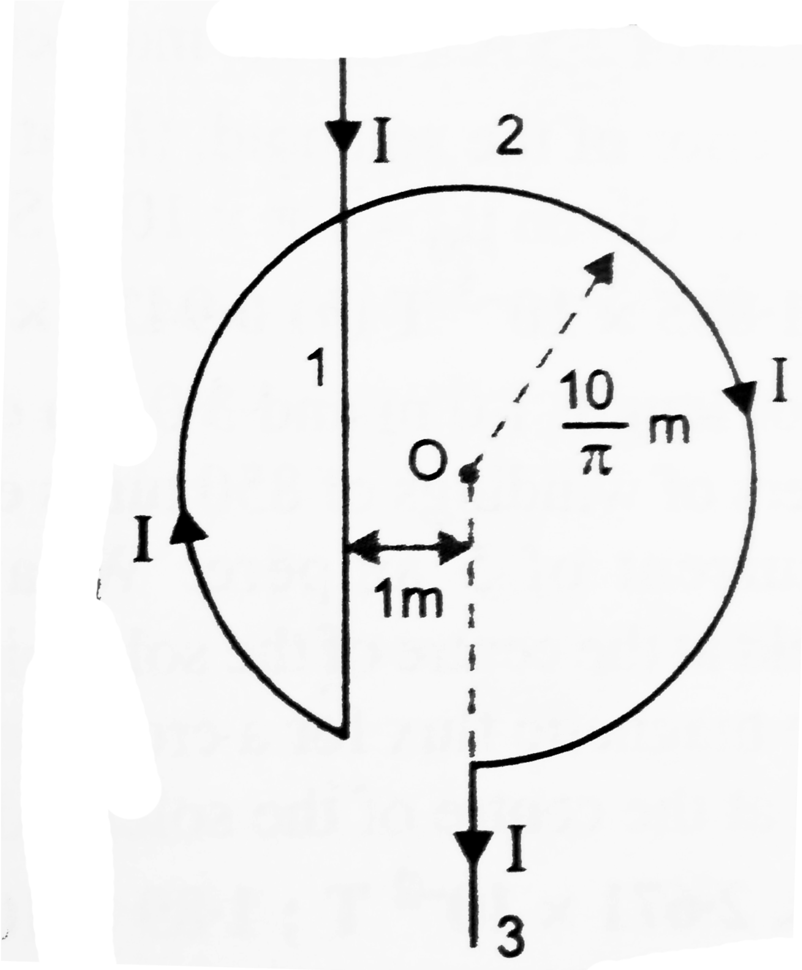
90. A long straight wire carrying current I is bent into the shape as shown in the figure. The circular portion of the wire has radius $(10/\pi)m$. The centre of this circle is at a distance $1m$ from the straight portion of the wire. What is the magnitude of the magnetic field at the centre of the circular portion? Given $\pi^2 = 10$.



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91. A long straight solid metal wire of radius R carries a current I, uniformly distributed over its circular cross-section. Find the magnetic field at a distance r from axis of wire (i) inside and (ii) outside the wire.

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92. A straight thick long wire of uniform cross-section of radius $5cm$ is carrying a steady current $5A$. Calculate the magnetic field at a point $2cm$ from the axis of wire, well inside the wire.

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93. A long straight solid conductor of radius $6cm$ carries a current of $8A$, which uniformly distributed over its circular cross-section. Find the magnetic field (a) at a distance of $3cm$ from the axis of the conductor (b) at a distance $10cm$ from the axis of the conductor.

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94. If the current density in a linear conductor of radius 'a' varies with r according to relation $J = kr^2$, where k is a constant and r is the distance of a point from the axis of conductor. Find the magnetic field induction at a point distance r from the axis, when (i) $r < a$ and (ii) $r > a$.

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95. A $0.5m$ long solenoid has 500 turns and has strength of magnetic field of $2.52 \times 10^{-3}T$ at its center. Find the current in the solenoid.

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96. A solenoid of length $0 \cdot 20m$, having 120 turns carries a current of $2 \cdot 5A$. Find the magnetic field: (a) in the interior of the solenoid, (b) at one end of the solenoid. Given $\mu_0 = 4\pi \times 10^{-7}$ S.I. units.

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97. A solenoid of length $1 \cdot 0m$ and $3 \cdot 0cm$ diameter has five layers of windings of 850 turns each hand carries a current of 5 ampere. What is the magnetic field at the centre of the solenoid? Also calculate the magnetic flux for a cross-section of the solenoid at the centre of the solenoid.

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98. A long wire carries a current of $20A$ along the directed axis of a long solenoid. The field due to a solenoid is $4mT$. Find the resultant field at a point $3mm$ from the solenoid axis.

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99. A copper wire having a resistance of $0 \cdot 02\Omega$ per metre is used to wind a 500 turns solenoid of radius $2 \cdot 0cm$ and length $30cm$. What should be the emf of the battery which when connected across the solenoid would produce a magnetic field at $10^{-2}T$, near the centre of the solenoid.

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100. A coil wrapped around a toroid has inner radius of $10 \cdot 0cm$ and an outer radius of $20 \cdot 0cm$. If the wire wrapped makes 600 turns and carries a current of $10 \cdot 0A$, what are the maximum and minimum values of magnetic field within the toroid?

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101. Two straight long conductors AOB and COD are perpendicular to each other and carry currents I_1 and I_2. Find the magnitude of magnetic field induction at a point P at a distance a from the point O in a direction perpendicular to the plane ABCD

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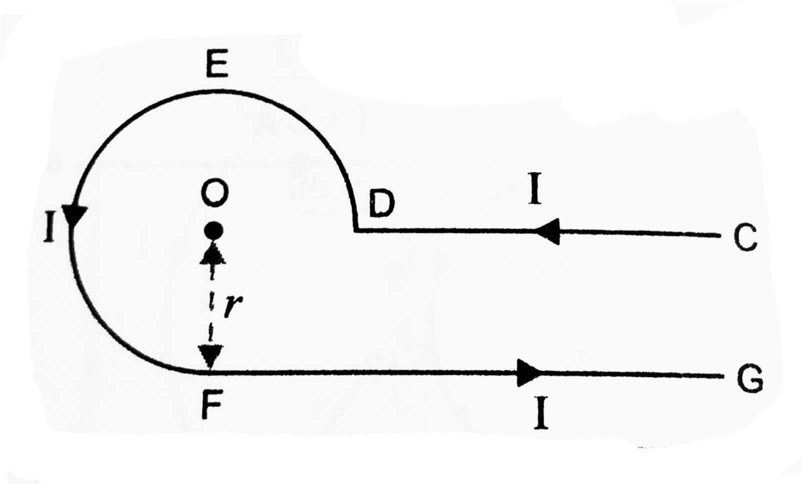
102. A current I is flowing in a conductor shaped as shown in figure. The radius of the curved part is r and length of straight portion is very large. Find the magnetic field induction at the centre O.



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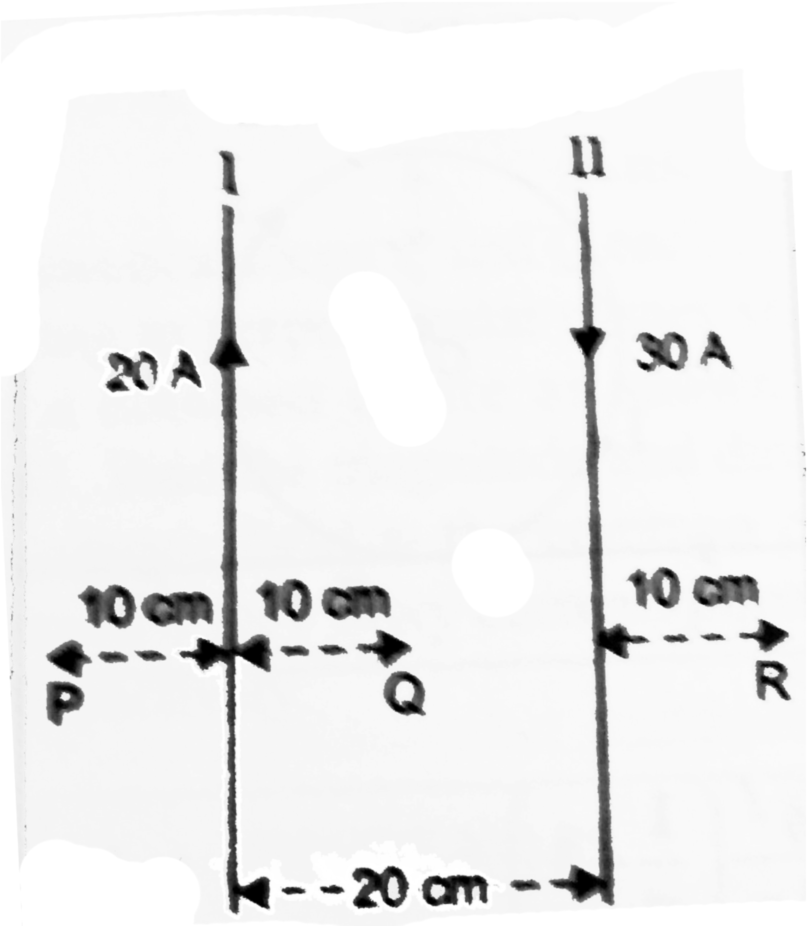
103. In the figure are shown two long parallel current carrying wires I and II. Find the magnitudes and directions of the magnetic field induction at the point P, Q and R in the plane of paper.



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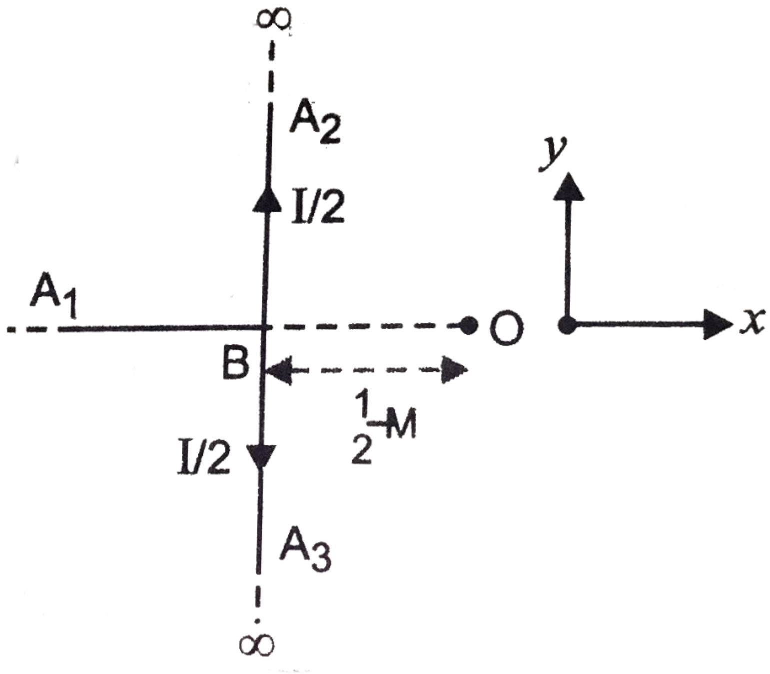
104. A current $I = IA$ flowing through an infinite long wire A_1 divides between two infinite long wires A_2 and A_3 at junction B.

The magnitude of the magnetic field at point O due to current through wires is :



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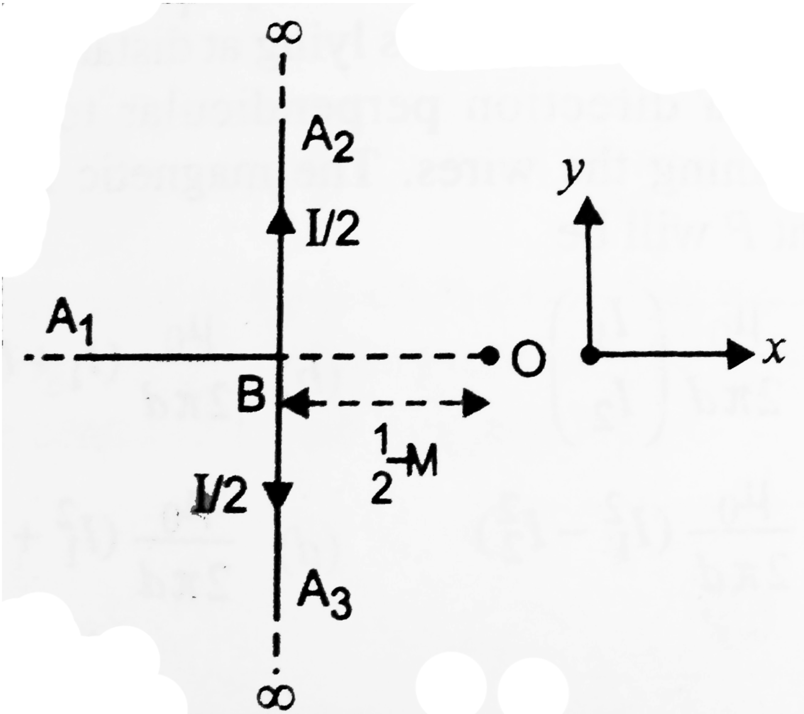
105. Electric currents I_1 and I_2 are flowing in two mutually perpendicular conductors as shown in figure. Find the equation of locus of zero magnetic field points.



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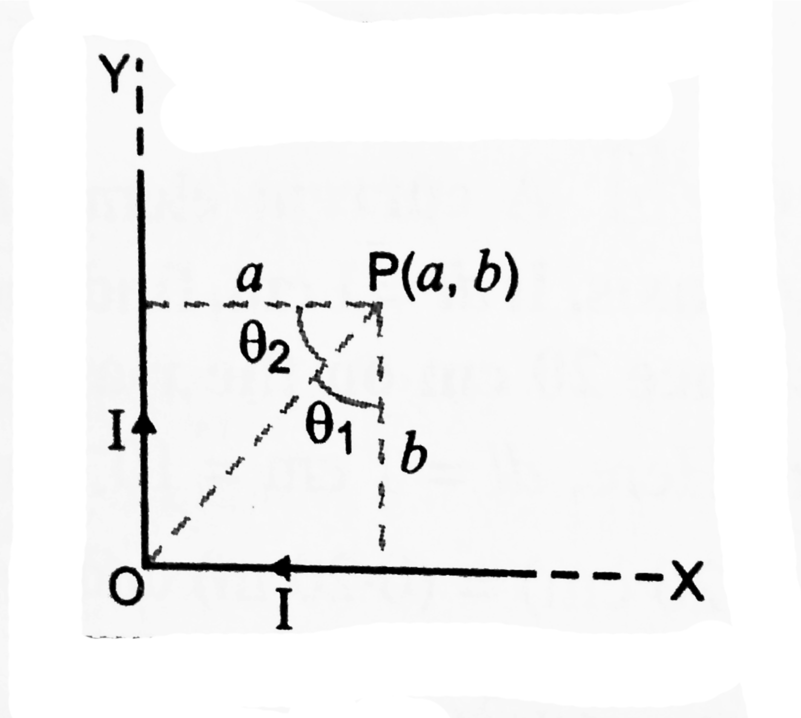
106. Two semi infinitely long straight current carrying conductors are held in the form as shown in figure. One common end of them is at the origin. If both the conductors carry same current I, find the value of the magnetic field induction at a point (a, b).



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107. An electron enters electric field of $10^4 V/m$ perpendicular to the field with a velocity of $10^7 m/s$. Find the vertical displacement of electron after 2 milliseconds. Mass of electron $= 9 \cdot 1 \times 10^{-31} kg$, charge on electron $= 1 \cdot 6 \times 10^{-19} C$.

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108. 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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109. An electron is moving northwards with a velocity $3 \cdot 0 \times 10^{7} ms^{-1}$ in a uniform magnetic field of $10T$ directed eastwards. Find the magnitude and direction of the magnetic force on the electron. $\left(e = 1 \cdot 6 \times 10^{-19} C\right)$

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110. A chamber is maintained a uniform magnetic field of $5 \times 10^{-3}T$. An electron with a speed of $5 \times 10^{7}ms^{-1}$ enters the chamber in a direction normal to the field. Calculate (i) radius of the path (ii) frequency of revolution of the electron.

Charge of electron $= 1 \cdot 6 \times 10^{-19}C$,

Mass of electron $= 9 \cdot 1 \times 10^{-31}kg$

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111. A proton projected in a magnetic field of 0.020 T travels along a helical path of radius 5.0 cm and pitch 20 cm. Find the components of the velocity of the proton along and perpendicular to the magnetic field. Take the mass of the proton $= 1.6X10^{-27}$kg.

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112. An electron after being accelerated through a potential difference of 100 V enters a uniform magnetic field of $0 \cdot 004T$, perpendicular to its direction of motion. Calculate the radius of the path described by the electron.

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113. A beam of electrons enters a uniform magnetic field of $0 \cdot 3T$ with a velocity of $4 \times 10^5 ms^{-1}$ at an angle of 60° to the field. Find the radius of the helical path taken by the beam. Also find the pitch of the helix (distance travelled by a proton parallel to the magnetic field during one period of rotation). Mass of proton is $1 \cdot 67 \times 10^{-27} kg$.

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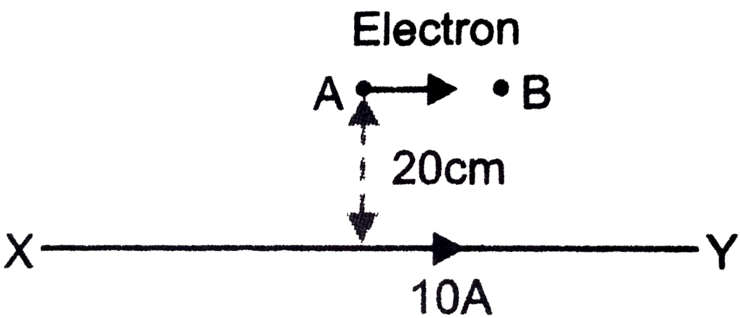
114. An infinite long straight conductor XY is carrying a current of $10A$. An electron is moving with a speed of $10^5 m^{-1}$ parallel to the conductor in air from point A to B, as shown in figure. The perpendicular distance between the electron and the conductor XY is $20cm$. Calculate the magnitude of the force experienced by the electron. Write the direction of this force.



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115. A proton is to circulate the earth along the equator with a speed of $1 \cdot 0 \times 10^7 ms^{-1}$. Find the minimum magnetic field which should be created at the equator for this purpose. The mass of proton $= 1 \cdot 7 \times 10^{-27} kg$ and radius of earth $= 6 \cdot 37 \times 10^{6} m$.

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116. A long straight wire carries a current of $2A$. An electron travels with a velocity of $4 \times 10^{4} ms^{-1}$ parallel to the wire $0 \cdot 1 mm$ from it, and in a direction opposite to the current. What force does the magnetic field of current exert on the moving electron. Charge on electron $= 1 \cdot 6 \times 10^{-19} C$.

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117. A monoenergetic electron of initial energy $18 keV$ moving horizontally is subjected to a horizontal magnetic field of $0 \cdot 4G$ normal to its initial direction. Calculate the vertical deflection of the beam over a distance of $30 cm$.

Mass of electron $= 9 \cdot 1 \times 10^{-31} kg$,

charge of electron $= 1 \cdot 6 \times 10^{-19} C$.

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118. A proton, a deutron and an alpha particle, after being accelerated through the same potential difference enter a region of uniform magnetic field $\vec{B}$, in a direction perpendicular to $\vec{B}$. Find the ratio of their kinetic energies. If the radius of proton's circular path is $7cm$, what will be the radii of the paths of deutron and alpha particle?

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119. A beam of proton passes undeflected with a horizontal velocity v, through a region of electric and magnetic fields, mutually perpendicular to each other and perpendicular to the direction of the beam. If the magnitudes of the electric and magnetic fields are $100kV/m$, $50mT$ respectively, calculate the velocity of the beam v.

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120. If the maximum value of accelerating potential provided by a radio frequency oscillator be $10kV$, calculate the number of revolutions made by an α-particle in a cyclotron to achieve one-tenth of the speed of light. Mass of proton $= 1 \cdot 67 \times 10^{-27}kg$, charge on proton $= 1 \cdot 6 \times 10^{-19}C$.

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121. A cyclotron's oscillator frequency is $10MHz$. What should be the operating magnetic field for accelerating α-particles ? If the radius of the dees is $60cm$, what is the kinetic energy of the α-

particle beam produced by the accelerator? Given, charge of an electron is $1 \cdot 6 \times 10^{-19} C$, mass of each nucleon is $1 \cdot 67 \times 10^{-27} kg$.

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122. A cyclotron has an oscillatory frequency of $10 MHz$ and a dee radius of $60 cm$. Calculate the magnetic field required to accelerate the deutrons of mass $3 \cdot 3 \times 10^{-27} kg$ and charge $1 \cdot 6 \times 10^{-19} C$. Find the energy of deutrons emerging from the cyclotron.

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123. An electron beam passes through a magnetic field of $2 \times 10^{-3} weber/m^2$ and an electric field of $1 \cdot 0 \times 10^4 Vm^{-1}$ both acting simultaneously. The path of electrons remaining undeviated, calculate the speed of the electrons. If the electric field is removed what will be the radius of the electron path?

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124. In a cyclotron, a magnetic field of $2 \cdot 4T$ is used to accelerate protons. How rapidly should the electric field between the dees be reversed? The mass and the charge of protons are $1 \cdot 67 \times 10^{-27} kg$ and $1 \cdot 6 \times 10^{-19} C$ respectively.

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125. What is the magnitude of force on a wire of length $0 \cdot 04m$ placed inside a solenoid near its centre, making an angle of 30° with its axis? The wire carries a current of $12A$ and the magnetic field due to the solenoid is of magnitude $0 \cdot 25T$.

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126. A conductor of length $20cm$ is placed (i) parallel (ii) perpendicular (iii) inclined at an angle 30°, to a uniform magnetic field of $2T$. If the charge of $10C$ passes through it in $5s$, find the force experienced by the conductor.

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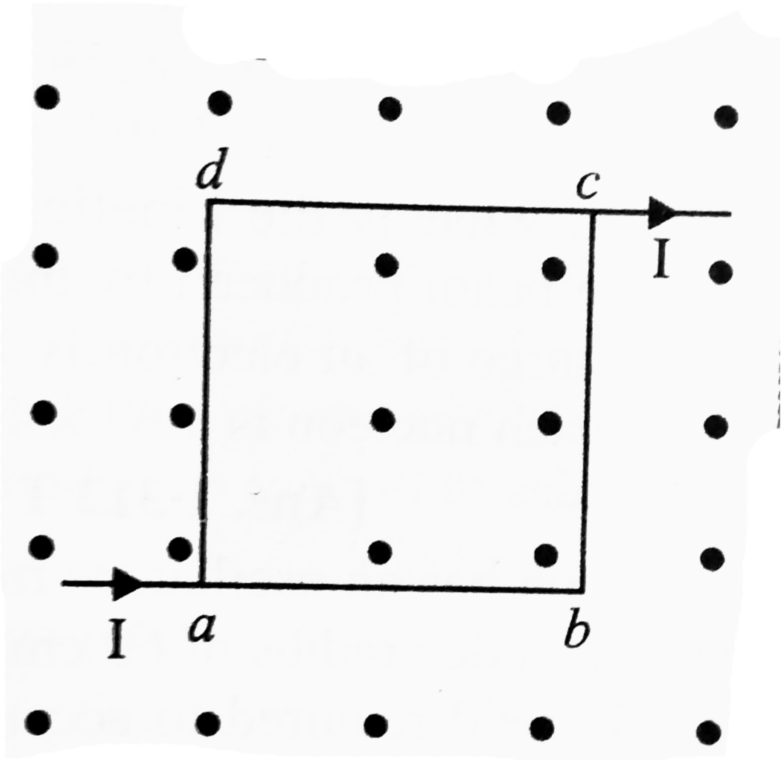
127. A current of $4A$ enters at the corner 'a' of a square frame of side $10cm$ and leaves at opposite corner 'c'. A magnetic field of $B = 0 \cdot 20T$ acts in a direction perpendicular to the plane of paper directed outwards. Find the magnitude and direction of the magnetic forces on the four arms of the frame.



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128. A horizontal wire $0 \cdot 1m$ long having mass $3g$ carries a current of $5A$. Find the magnitude of the magnetic field which must act 30° to the length of the wire inorder to support its weight.

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129. On a smooth inclined plane at 30° with the horizontal a thin current carrying metallic rod is placed parallel to the horizontal ground. The plane is located in a uniform magnetic field of $0 \cdot 15 tesla$ in the vertical direction. For what value of current can the rod ramain stationary? The mass per unit length of rod is $0 \cdot 30 kgm^{-1}$.

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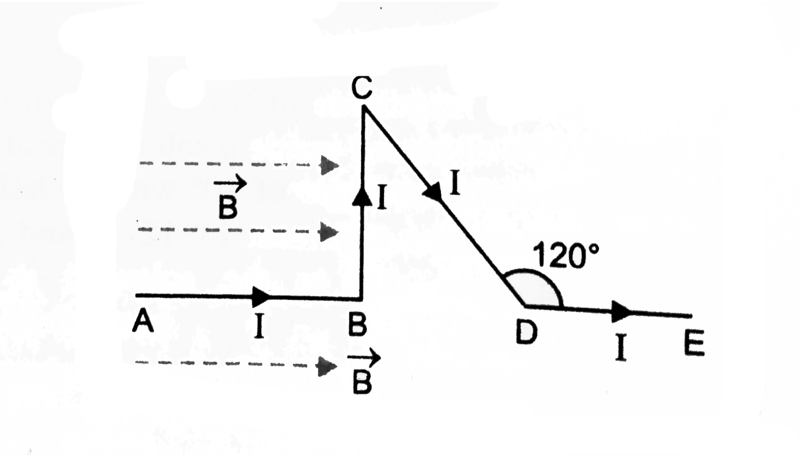
130. Find the magnitude of the magnetic force on the segment CD of length $30 cm$ placed in a magnetic field of $0 \cdot 3T$ and a current of

$4A$ flows through it as shown in figure.



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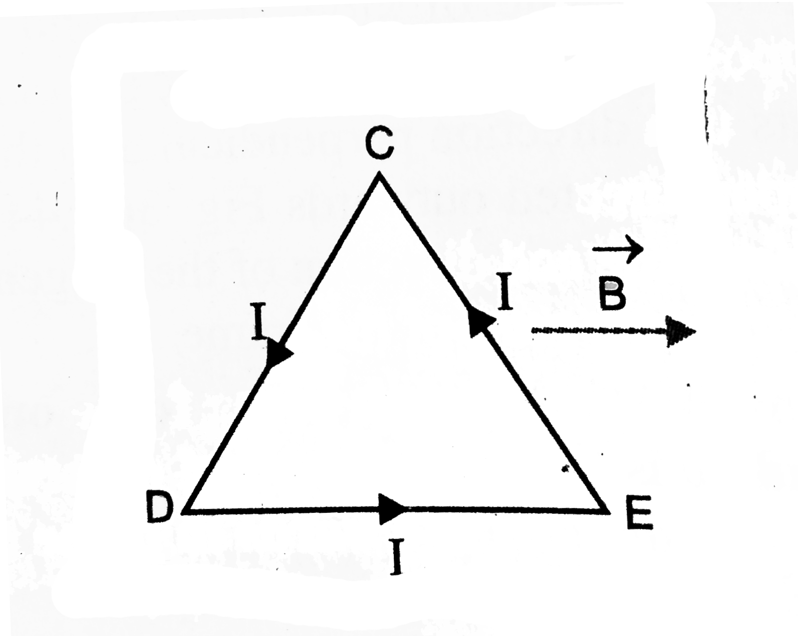
131. Figure, shows an equilateral triangular loop CDE, carrying current I. Length of each side of triangle is l. If a uniform magnetic field exists parallel to side DE of loop, then find the foces acting on the three wires CD, DE and EC separately.



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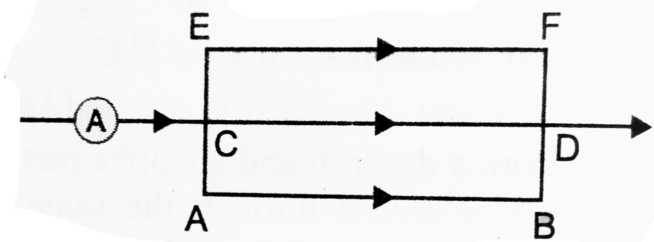
132. Three long parallel wires AB, CD and EF of equal resistance are connected as shown in figure. The separation between the neighbouring wires is $2 \cdot 0 cm$ and wires AE and BF supplied to the wires and ammeter reads $12A$.

(a) or wire AB (b) of wire CD.



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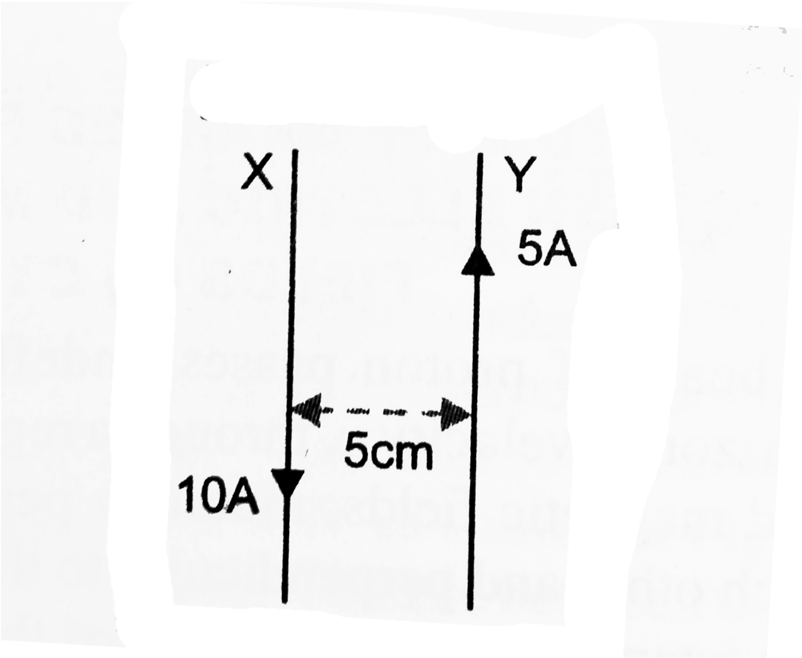
133. Two long parallel straight wires X and Y separated by a distance $5cm$ in air carry currents of $10A$ and $5A$ respectively in opposite directions. Calculate the magnitude and direction of force on a $20cm$ length of the wire Y. Figure



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134. A short conductor of length $5 \cdot 0cm$ is placed parallel to a long conductor of length $1 \cdot 5cm$ near its centre. The conductors carry currents $4 \cdot 0A$ and $3 \cdot 0A$ respectively in the same direction. What is the total force experienced by the long conductor, when they are $3 \cdot 0cm$ apart?

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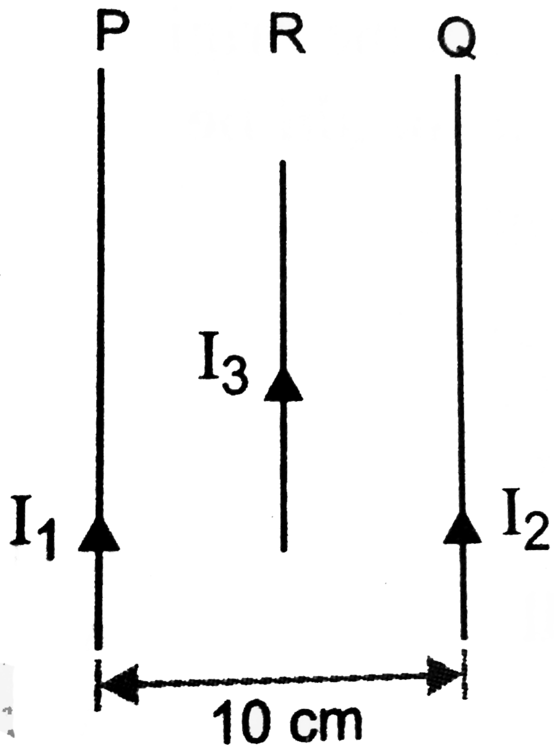
135. Two very long, straight parallel wires P and Q carry currents $5A$ and $10A$ respectively and are at a distance of $10cm$ apart, as shown in figure. If a third wire R (length $10cm$) having a current of $5A$ is placed in middle between them, how much force will be acting on R? The direction of current in all the wires is the same.



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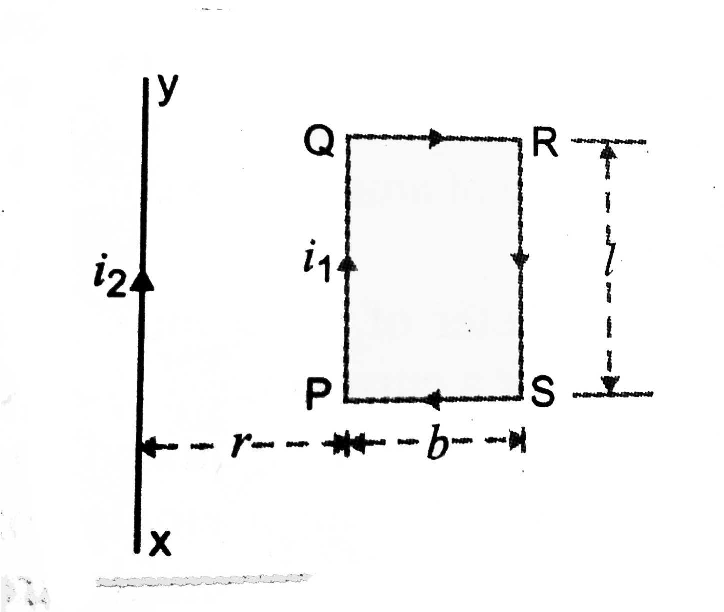
136. A rectangular loop of sides $27cm \times 12cm$ carries a current of $12A$. It is placed with its longer side parallel to the long straight conductor $3 \cdot 0 cm$ apart and carrying a current of $20A$. Figure. (i) Find the net force on the loop (ii) What will be the net force on the loop if the current in the loop be reversed?



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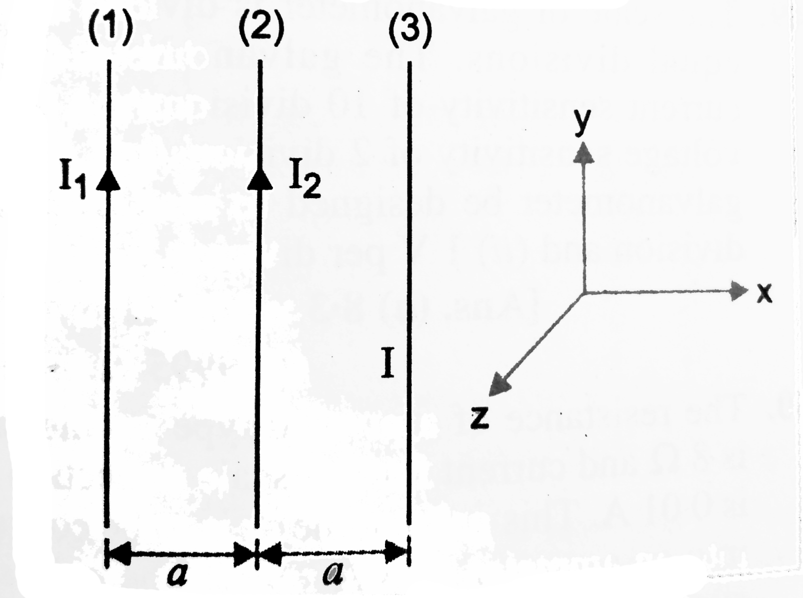
137. Three long straight parallel wires are kept as shown in figure. The wire (3) carries a current I.



(i) The direction of flow of current I in wire (3), is such that the net force, on wire (1), due to other two wires, is zero (ii) By reversing the direction of I, the net force, on the wire (2) due to the other two wires, becomes zero.

What will be the directions of current I, in the two cases? Also obtain the relation between the magnitudes of current I_1, I_2 and I.

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138. Calculate the torque on a 200 turns rectangular coil of length $20cm$ and breadth $10cm$ carrying a current of $10A$, when placed in a magnetic field. The plane of the coil is making an angle of 60° with a magnetic field of $4T$.

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139. A cicular coil of 200 turns and radius $10cm$ is placed in a uniform magnetic field of $0 \cdot 5T$, normal to the plane of the coil. If the current in the coil is $3 \cdot 0A$, calculate the (a) total torque on the coil (b) total force on the coil (c) average force on each electron in the coil, due to the magnetic field. Assume that the area of cross-section of the wire to be $10^{-5}m^2$ and the free electron density is $10^{29}m^{-3}$.

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140. A circular coil of 200 turns, radius $5cm$ carries a current of $2 \cdot 5A$. It is suspended vertically in a uniform horizontal magnetic field of $0 \cdot 25T$, with the plane of the coil making an angle of 60° with the field lines. Calculate the magnitude of the torque that must be applied on it to prevent it from turning.

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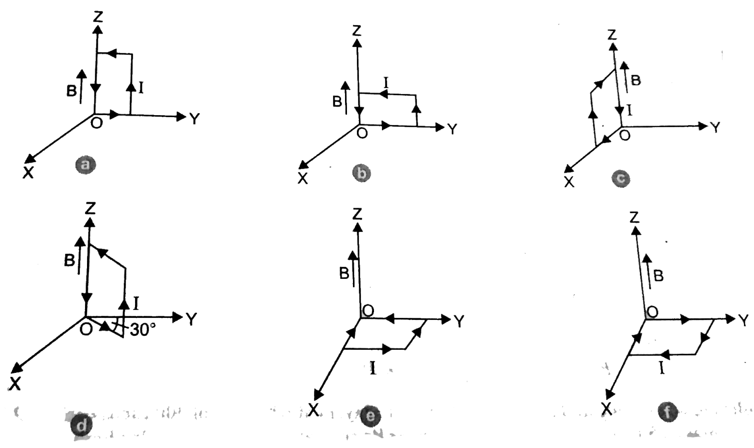
141. A uniform magnetic field of $3000G$ is established along the positive z-direction. A rectangular loop of sides $10cm$ and $5cm$ carries a current $12A$. What is the torque on the loop in the different cases shown in the figure. What is the force on each case? Which case corresponds to stable equilibrium?



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142. A coil in the shape of an equilateral triangle of side 0.02 m is suspended from a vertex such that it is hanging in a vertical plane between the pole pieces of a permanent magnet producing a horizontal magnetic field of $5 \times 10^{-2} T$. Find the couple acting on the coil when a current of 0.1 A is passed through it and the magnetic field is parallel to its plane.

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143. The coil of a galvanometer is $0 \cdot 02 \times 0 \cdot 8m^2$. It consists of 200 turns of the wire and is in a magnetic field of $0 \cdot 20T$. The restoring torque constant of suspension fibre is $10^{-6} Nm/degree$. Assuming magnetic field to be radial (a) What is the maximum current that can be measured by this galvanometer if scale can accommodate 45° deflection? (b) What is the smallest current that can be detected if minimum observed deflection is $0 \cdot 1 degree$?

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144. A galvanometer coil is replaced by another coil of diameter one-fourth of the original diameter and the total number of turns as ten times the original number. What will be the new deflection if the same current is passed through it?

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145. The coil of moving coil galvanometer has an effective area $6 \times 10^{-2} m^2$. It is suspended in a magnetic field of $3 \times 10^{-2} Wbm^{-2}$. If the torsional constant of the suspension fibre is $5 \times 10^{-9} Nmdeg^{-1}$, finds its current sensitivity in degree per micro-ampere.

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146. If the current current sensitivity of a moving coil galvanometer is increased by 20%, its resistance also increases by $1 \cdot 5$ times. How will the voltage sensitivity of the galvanometer be affected?

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147. To increase the current sensitivity of a moving coil galvanometer by 50% its resistance is increased so that the new resistance becomes twice its initial resistance. By what factor does its voltage sensitivity change?

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148. A galvanometer needs $30mV$ for a full scale deflection of 30 divisions. Determine its voltage sensitivity. What must be its resistance if its current sensitivity is $2\text{div}/\mu A$?

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149. A moving coil meter has the following particulars: Numbers of turns, $n = 24$, Area of coil, $A = 2 \cdot 0 \times 10^{-3} m^2$, magnetic field strength, $B = 0 \cdot 20T$. Resistance of the coil, $R = 14\Omega$. (a) Indicate a simple way to increase the current sensitivity of the meter by

25%. (It is not easy to change A or B). (b) If in so doing, the resistance of the coil increases by 7Ω, is the voltage sensitivity of the modified meter greater or lesser than the original meter?

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150. A galvanometer with a coil of resistance 12.0Ω shows full scale deflection for a current $2 \cdot 5mA$. How will you convert the meter into (i) an ammeter of range 0 to $7 \cdot 5A$ (b) a voltmeter of range 0 to 10V.

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151. A resistance of 900Ω is connected in series with a galvanometer of resistance 100Ω. A potential difference of 1 Volt produces 100 division deflection in galvanometer. Find the figure of merit of galvanometer.

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152. An ammeter gives full scale deflection with a deflection for a current of $0 \cdot 05A$. Calculate the length of shunt wire required to convert the galvanometer into an ammeter of range 0 to $5A$. The diameter of the shunt wire is $2mm$ and its resistivity is $5 \times 10^{-7} \Omega m$.

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153. A galvanometer of resistance 50Ω gives full deflection for a current of $0 \cdot 05A$. Calculate the length of shunt wire required to convert the galvanometer into an ammeter of range 0 to $5A$. The diameter of the shunt wire is $2mm$ and its resistivity is $5 \times 10^{-7} \Omega m$.

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154. A galvanometer can be converted into a voltmeter of certain range by connecting a resistance of 880Ω in series with it. When the resistance of 420Ω is connected in series, the range becomes half. Find the resistance of galvanometer.

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155. The scale of galvanometer is divided into 150 equal divisions. The galvanometer has a current sensitivity of $10\text{divisions}/mA$ and the voltage sensitivity of $2\text{divisions}/mV$. How the galvanometer be designed to read (i) 6A per division and (ii) 1 V per division?

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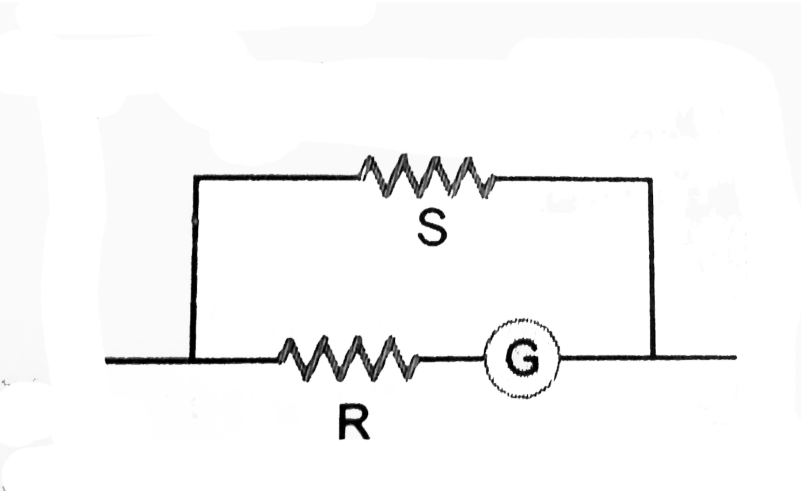
156. The resistance of a pivoted type galvanometer is 8Ω and current for full scale deflection on it is $0 \cdot 01A$. This galvanometer is to be converted into an ammeter of $5A$ range. The only shunt available is $0 \cdot 02\Omega$. Find the value of R to be connected in series with the galvanometer coil, figure.



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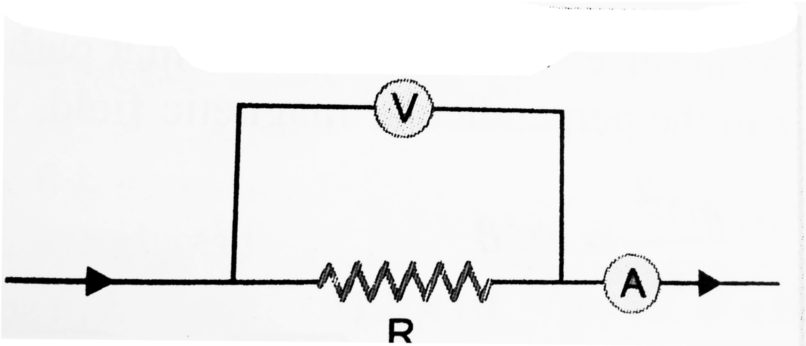
157. The voltmeter V in the figure. Reads $117V$ and the ammeter A reads $0 \cdot 13A$. The resistance of the voltmeter is 9000Ω and the resistance of ammeter is $0 \cdot 015\Omega$. Compute (i) the resistance R, (ii) the power input to R.



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158. In a galvanometer there is a deflection of 10 divisions per $50mA$. The internal resistance of the galvanometer is 60Ω. If a shunt of $2 \cdot 5\Omega$ is connected to the galvanometer and there are 50 divisions in all on the scale of galvanometer what maximum current can this galvanometer read?

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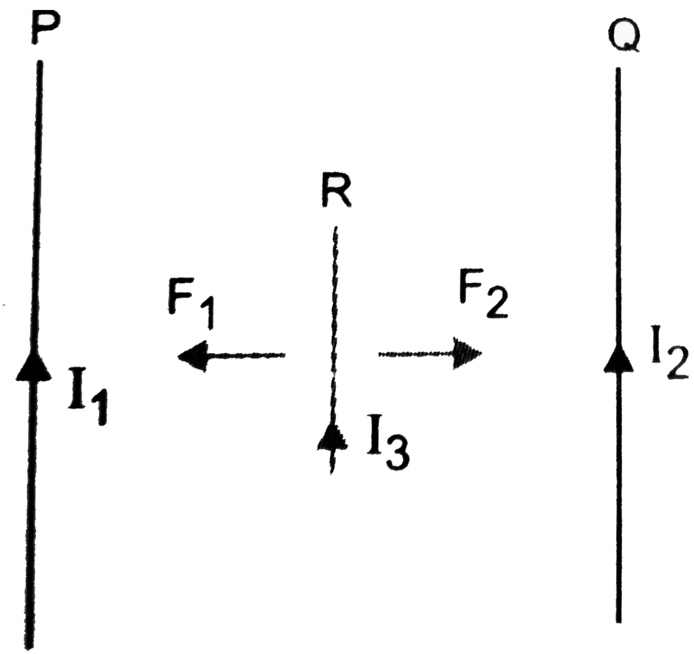
159. Two very long straight wires P and Q carry currents of $10A$ and $20A$ respectively, and are at a distance $20cm$ apart. If a third wire R (length $15cm$) having a current of $10A$ is placed in middle between them, how much force will act on R? The direction of current in all the three wires is the same.



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160. A moving coil meter has the following particulars. Number of turns, $N = 20$, Area of the coil, $A = 2 \cdot 0 \times 10^{-3} m^2$, Magnetic field strength, $B = 0 \cdot 20T$, Resistance of the coil, $R = 12\Omega$.

(a) Indicate a simple way to increase the current sensitivity of the meter by 20% (It is not easy to change A or B).

(b) If in so doing, the resistance of the coil increases to 18Ω, is the voltage sensitivity of the modified meter greater or lesser than the original meter?

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161. A proton (charge $= 1 \cdot 6 \times 10^{-19} C$, mass $m = 1 \cdot 67 \times 10^{-27} kg$) is shot with a speed $8 \times 10^6 ms^{-1}$ at an angle of $30°$ with the x-axis. A uniform magnetic field $B = 0 \cdot 30T$ exists along the x-axis. Show that the path of the proton is helix and find the radius of the helix.

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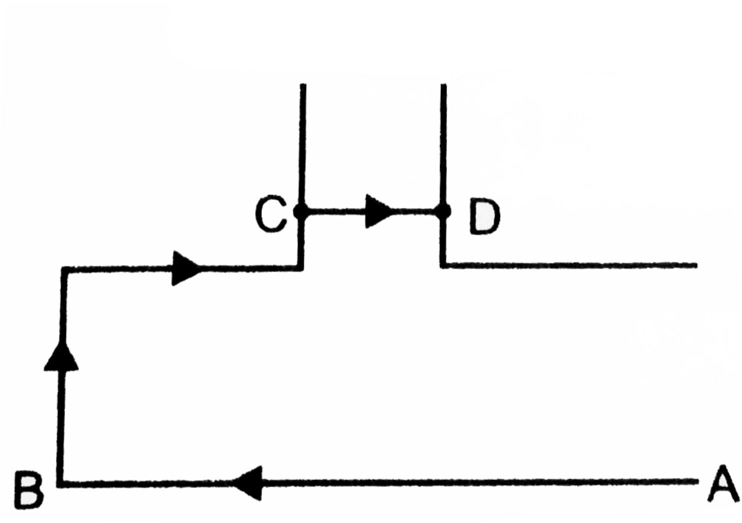
162. In figure, a long wire AB is placed on a table. A wire CD $10cm$ long, is just above AB. It can slide up and down on two vertical wires. If the wires carry a current of $20A$, then how much above AB, will the wire CD settle? The mass of the wire CD is $0 \cdot 50$ gram.



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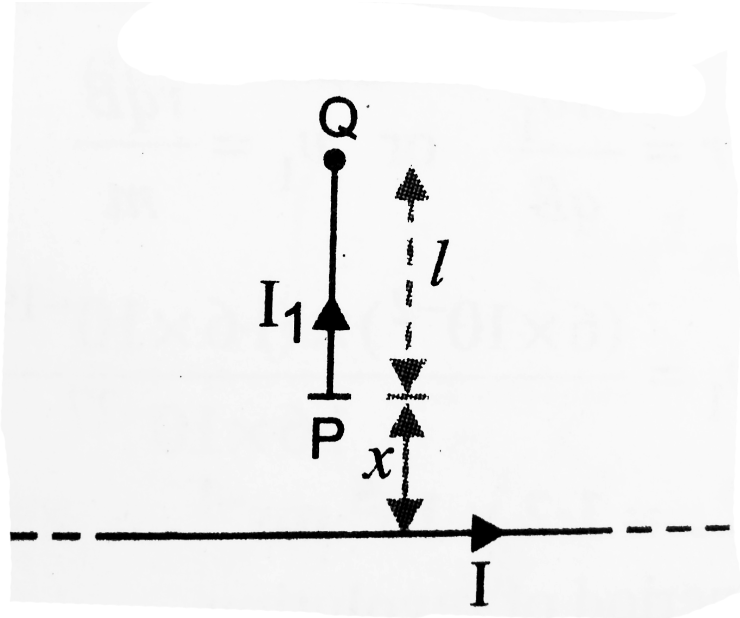
163. Find the force on the conductor carrying current I_1 as shown in figure.



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164. A bar magnet of magnetic moment of $5 \cdot 0 Am^2$ has poles $20 cm$ apart. Calculate the pole strength.

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165. A steel wire of length l has a magnetic moment M. It is bent into a semicircular arc. What is the new magnetic moment?

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166. Two thin bar magnets of pole strengths $25Am$ and $48Am$ respectively and length $0 \cdot 20m$ and $0 \cdot 25m$ respectively are placed at right angles to each other with the N-pole of first angles to each other with the N-pole of first touching the S-pole of the second. Find the magnetic moment of the system.

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167. The force between two magnetic poles in air is $9 \cdot 604mN$. If one pole is 10 times stronger than the other, calculate the pole strength of each. Given distance between two poles=$10cm$.

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168. Two identical magnets with a length $10cm$ and weights $50gf$ each are arragned freely with their like poles facing in a vertical glass tube. The upper magnet hangs in air above the lower one so that the distance between the nearest poles of the magnets is $3mm$. Determine the pole strength of the poles of these magnets.

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169. A bar magnet of length $10cm$ has a pole strength of $10Am$. Calculate the magnetic field at a distance of $0 \cdot 2m$ from its centre at a point on its (i) axial line (ii) equatorial line.

Watch Video Solution

170. Two small magnets are placed horizontally perpendicular to magnetic meridian. Their north poles are at $30cm$ east and $20cm$ west from a compass needle. Compare the magnetic moments of the magnets, if compass needle remains undeflected.

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171. The earth's field, it is claimed, roughly approximates the field due to a dipole of magnetic moment $8 \times 10^{22} JT^{-1}$ located at its centre. Check the order of magnitude of this number in some way.

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172. The magnetic moment of the assumed dipole at the earth's centre is $8.0 \times 10^{22} Am^2$. Calculate the magnetic field B at the geomagnetic poles of the earth. Radius of the earth is $6400 km$.

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173. The magnetic field at a point on the magnetic equator is found to be $3 \cdot 1 \times 10^{-5} T$. Taking the earth's radius to be $6400 km$, calculate the magnetic moment of the assumed dipole at the earth's centre.

Watch Video Solution

174. A bar magnet of length $10 cm$ has a pole strength of $20 Am$. Find the magnetic field strength at a distance of $10 cm$ from its centre on (i) its axial line and on (ii) its equatorial line.

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175. A current of $5A$ is flowing through a 10 turn circular coil of radius $7cm$. The coil lies in XY plane. What is the magnitude and direction of magnetic dipole moment associated with it?

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176. The magnetic dipole moment of earth is $6 \cdot 4 \times 10^{21} Am^2$. If we consider it to be due to a current loop wound around the magnetic equator of the earth, then what should be the magnitude of the current? Take earth to be a sphere of radius $6400 km$.

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177. A circular coil of 300 turns and diameter $14 cm$ carries a current of $15A$. What is the magnetic moment of the loop?

Watch Video Solution

178. A magnetised needle of magnetic moment $4 \cdot 8 \times 10^{-2} JT^{-1}$ is placed at 30° with the direction of uniform magnetic field of magnitude $3 \times 10^{-2} T$. What is the torque acting on the needle?

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179. A bar magnet placed in a uniform magnetic field of strength $0 \cdot 3T$ with its axis at 30° to the field experiences a torque of $0 \cdot 06N - m$. What is the magnetic moment of the bar magnet?

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180. Calculate the work done in rotating a magnet of magnetic moment $3 \cdot 0 JT^{-1}$ through an angle of 60° from its position along a magnetic field of strength $0 \cdot 34 \times 10^{-4} T$.

Watch Video Solution

181. A bar magnet is suspended in a region where it is acted upon by two magnetic fields inclined at an angle of 60° to each other. One of the fields has a magnitude of $1 \cdot 2 \times 10^{-2} T$. The magnet attains stable equilibrium at an angle of 15° with this field. Calculate the magnitude of other field. Ignore earth's field.

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182. Two magnects of magnetic moments M and $M\sqrt{3}$ are joined to form a cross (+). The combination is suspended freely in a uniform magnetic field. In equilibrium position, the magnet of magnetic moment M makes an angle θ with the field. Determine θ.

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183. A short bar magnet placed with its axis at 30° with a uniform external magnetic field of $0 \cdot 16T$ experiences a torque of magnitude $0 \cdot 032J$. Estimate the magnetic moment of the magnet. If the bar were free to rotate, which orientations would correspond to its (i) , stable and (ii), unstable equilibrium? What is the potential energy of the magnet in the two case?

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184. A circular coil of 100 turns and having a radius of $0 \cdot 05m$ carries a current of $0 \cdot 1A$. Calculate the work required to turn the coil in an external magnetic field of $1 \cdot 5T$ through 180° about an axis perpendicular to the magnetic field. The plane of the coil is initially at right angles to the magnetic field.

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185. A magnetic needle lying parallel to a magnetic field needs $2J$ work to turn it through 60°. Calculate the torque required to maintain the needle in this position.

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186. A vertical coil of sides $5cm \times 2cm$ has 10 turns and carries $2A$ current. Calculate torque on the coil, when it is placed in a uniform horizontal magnetic field of $0 \cdot 1T$ with its plane at 60° to the field.

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187. A bar magnet with poles $\sqrt{3}cm$ apart and pole strength $14 \cdot 4Am$ rests with its centre on a frictionless pivot. The magnet is held in equilibrium at an angle of 60° to a uniform magnetic field of intensity $0 \cdot 20T$ by applying a force F at right angles to its axis, $0 \cdot 1m$ from its pivot. What is the value of force F?

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188. A magnetic dipole is under the influence of two magnetic fields. The angle between the field directions is 60° and one of the fields has a magnitude of $1 \cdot 25 \times 10^{-2}T$. If the dipole comes to stable equilibrium at an angle of 15° with this field, find the magnitude of other magnetic field.

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189. Vertical component of earth's magnetic field at a place is $\sqrt{3}$ times its horizontal component. If total intensity of earth's magnetic field at the place is $0 \cdot 4 Gauss$, find (i) angle of dip (ii) horizontal component of earth's magnetic field.

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190. The declination at a place is 15° west of north. In which direction should a ship be steered so that it reaches a place due east?

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191. If the horizontal component of earth's magnetic field at a place is $0 \cdot 4 \times 10^{-4} T$ where dip is 60°, what are the values of vertical component and resultant magnetic field?

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192. A dip circle shows an apparent dip of 60° at a place where true dip is 45°. If dip circle is rotated through 90°, what apparent value of dip will it show?

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193. A compass needle whose magnetic moment is $60Am^2$ points geographic north at a certain place where $H = 40\mu T$. The compass needle experience a torque of $1 \cdot 2 \times 10^{-3} N - m$. What is the declination at the place?

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194. A magnetic needle free to rotate in a vertical plane parallel to magnetic meridian has its north tip down at 60° with the horizontal. The horizontal component of earth's magnetic field at that place is $0 \cdot 4G$. Determine the magnitude of earth's magnetic field at the place.

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195. A ship is sailing due west according to Mariner's compass. If the declination of the plane is 15° east, what is the true direction of ship?

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196. The declination at a place is 20° west. In what direction should a ship be steered so that it reaches geographic north east?

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197. The true dip at a place is 30°. In what plane is the dip apparently 60°?

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198. The true value of dip at a place is 45°. If the vertical plane carrying the needle is turned through 60° from the magnetic meridian, find the inclination of the needle (i.e. what will be the apparent value of dip)?

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199. If θ_1 and θ_2 be the apparent angles of dip observed in two vertical planes at right angles to each other, then show that the true angle of dip, θ is given by $\cot^2\theta = \cot^2\theta + \cot^2\theta$.

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200. A magnetic needle is free to rotate in a vertical plane which makes an angle of 60° with the magnetic meridian. If the needle stays in a direction making an angle of $\tan^{-1}\left(2/\sqrt{3}\right)$ with the horizontal, what would be the true dip at that place?

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201. At 45° to magnetic meridian, the apparent dip is 30°. What is the true value of dip?

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202. A ship sails due east according to compass. If declination at that place is 19° east of north. What is the true direction of ship?

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203. A bar magnet of length $10cm$ is placed in the magnetic meridian with its north pole pointing towards the geographical north. A neutral point is obtained at a distance of $12cm$ from the centre of the magnet. Find the magnetic moment of the magnet, when $H = 0 \cdot 34 gauss$.

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204. A very short bar magnet has magnetic moment $1 \cdot 4175 JT^{-1}$. It is placed (i) with its north pole pointing towards geographic north (ii) with its north pole pointing towards geographic south. If horizontal component of earth's field at the place is $0 \cdot 42 gauss$, calculate the distance of the neutral points from the magnet.

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205. A bar magnet $30cm$ long is placed in magnetic meridian with its north pole pointing south. The neutral point is observed at a distance of $30cm$ from its centre. Calculate the pole strength of the magnet. Given horizontal component of earth's field is $0 \cdot 34G$.

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206. A short bar magnet of magnetic moment $0 \cdot 5JT^{-1}$ is placed with its magnetic axis in the magnetic meridian, with its north pole pointing geographic north. A neutral point is obtained at a distance of $0 \cdot 1m$ from the centre of the magnet. Find the horizontal component of earth's magnetic field.

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207. A neutral point is found on the axis of a bar magnet at a distance of $10cm$ from one end. If the length of the magnet is $10cm$ and $H = 0 \cdot 3gauss$, find the magnetic moment of the magnet.

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208. The magnetic needle of a tangent galvanometer is deflected at an angle of 30° due to magnet. The horizontal component of earth's magnetic field $0 \cdot 34 \times 10^{-4}T$ is along the plane of the coil. What is magnetic intensity?

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209. Two tangent galvanometers, A and B have their number of turns in the ratio $3:1$ and diameters of coils in the ratio $4:1$.

Explain with reason (i) Which galvanometer has greater reduction factor? (ii) Which galvanometer shows greater deflection, when both are connected in series to a d.c. source?

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210. Two tangent galvanometers differ only in the matter of number of turns in the coil. On passing current through the two joined in series, the first shows a deflection of 35° and the other shows 45° deflection. Compute the ratio of their number of turns.

Take $\tan 35^\circ = 0 \cdot 7$

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211. Two tangent galvanometers have coils of the same radii, differing only in their number of turns. They are connected in series. When a steady current is passed in the circuit, the mean deflections in the galvanometer are θ_1 and θ_2. Deduce an expression for the ratio of number of turns of the galvanometer.

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212. A 2 turn coil of radius $10cm$ is placed with its plane in magnetic meridian. A small magnetic needle is suspended at the centre of the coil by a torsion free silk thread. On passing a current through the coil, the needle is deflected through 45°. Calculate the strength of the current if horizontal component of earth's field is $1 \cdot 6 \times 10^{-5}T$

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213. A compass needle whose magnetic moment is $60Am^2$ pointing geograhic north at a certain place, where the horizontal component of earth's magnetic field is $40 \mu Wbm^{-2}$ experiences a torque $1 \cdot 2 \times 10^{-3} Nm$. What is the declination of the place?

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214. A long straight horizontal cable carries a current of $3 \cdot 3A$ in the direction 10° south of west to 10° north of east. The magnetic meridian of the plane happens to be 10° west of the geographic meridian. The earth's magnetic field at the location is $0 \cdot 33G$ and the angle of dip is zero degree. Locate the positions of neutral points?

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215. A magnet $15cm$ long with poles of strength $250Am$ lies on a table. Find the magnitude of the magnetic intensity B at a point P, $20cm$ directly above the north pole of the magnet.

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216. Two identical short bar magnets each of magnetic moment $12 \cdot 5Am^2$ are placed at a separation of $10cm$ between their centres, such that their axes are perpendicular to each other. Find the magnetic field at a point midway between the two magnets.

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217. A closely wound solenoid of 2000 turns and area of cross section $1 \cdot 6 \times 10^{-4}m^2$, carrying a current of $4 \cdot 0A$ is suspended through its centre allowing it to turn in a horizontal plane. What is the magetic moment associated with the solenoid? What are the force and torque on the solenoid if a uniform horizontal field of $7 \cdot 5 \times 10^{-2}T$ is set up at an angle of 30° with the axis of the solenoid?

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218. An electron is revolving in a hydrogen atom in a circular orbit of radius 4Å making $10^{15}rps$. What is the magnetic moment associated with this electron?

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219. An electron in an atom revolves around the nucleus in an orbit of radius $0 \cdot 53\text{Å}$. Calculate the equivalent magnetic moment, if the frequency of revolution of electron is $6 \cdot 8 \times 10^{9}MHz$.

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220. A current of $4A$ flows through a plane circular coil of radius $4cm$ having 20 turns. Calculate dipole of moment of the coil.

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221. The dipole moment of a coil of 200 turns carrying a current of $3A$ is $9 \cdot 24Am^2$. What is the diameter of the coil?

Watch Video Solution

222. A magnet of magnetic moment $2 \cdot 5Am^2$ weighs $66g$. If density of material of the magnet is $7500kg/m^3$, find the intensity of magnetisation.

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223. Assume that each iron atom has a permanent magnetic moment equal to 2 Bohr magnetons (1 Bohr magneton equals $9.27 \times 10^{-24} Am^2$). The density of atoms in iron is 8.52×10^{28} atoms m^{-3}. (a) Find the maximum magnetization I in a long cylinder of iron. (b) Find the maximum magnetic field B on the axis inside the cylinder.

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224. A bar magnet made of steel has a magnetic moment of $2.5 Am^2$ and mass of $6.6 \times 10^{-5} kg$. If the density of steel is $7.9 \times 10^3 kgm^{-3}$, find the intensity of magnetization of the magnet.

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225. The maximum value of the permeability of μ metal (77% Ni, 16% Fe, 5% Cu, 2% Cr) is $0.128 TmA^{-1}$. Find the maximum relative permeability and susceptibility.

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226. A magnetising field of $1500A/m$ produces a flux of $2 \cdot 4 \times 10^{-5}$ weber in a bar of iron of cross-sectional area $0 \cdot 5cm^2$. Calculate the permeability and susceptibility of the iron bar used.

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227. A Rowland rign of mean radius $18cm$ has 3500 turns of wire wound on a ferromagnetic core of relative permeability 800. What is the magnetic field in the core for a magnetising current of $1 \cdot 2amp.?$

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228. An iron rod of $0 \cdot 2cm^2$ area of cross-section is subjected to a magnetising field of $1200Am^{-1}$.

(i) permeability, (ii) magnetic flux produced.

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229. Calculate the magnetic field intensity at a distance of $20cm$. from a pole of strength $40Am$ in air. Find the magnetic induction at the same point.

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230. A toroid has 2000 turns. The inner & outer radii of its core are $11cm$ and $12cm$ respectively. The magnetic field in the core for a current of $0 \cdot 7A$ is $2 \cdot 5T$. What is relative permeability of core?

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231. The magnetic field B and the magnetic intensity H in a material are found to be $1.6T$ and $1000Am^{-1}$ respectively. Calculate the relative permeability μ, and the susceptibility χ of the material.

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232. The maximum value of permeability of μ-metal $(77\% Ni, 16\% Fe, 5\% Cu, 2\% Cr)$ is $0 \cdot 126T - m/A$. Find the maximum relative permeability and susceptibility.

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233. Calculate permeability and susceptibility of a magnetic bar of cross-section $0 \cdot 1cm^2$ having magnetic flux of $2 \cdot 41 \times 10^{-5}Wb$ due to magnetic intensity of $3200Am^{-1}$.

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234. A ring of mean radius $15cm$ has 3500 turns of wire wound on a ferromagnetic core of relative permeability 800. What is the magnetic field in the core for a magnetising current of $2 \cdot 4A$?

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235. The magnetic susceptibility of a paramagnetic substance at $-73^{\circ}C$ is $0 \cdot 006$. What will be its value at $-173^{\circ}C$?

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236. The hysterisis loss of a sample of iron is $300 Jm^{-3} cycle^{-1}$. If density of iron is $7500 kg/m^3$ and mass of iron piece is $15 kg$, calculate energy lost/hour when the frequency of magnetisation/demagnetisation used in $50 c/s$.

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237. An iron sample having mass $8 \cdot 4 kg$ is repeatedly taken over cycles of magnetisation and demagnetisation at a frequency of $50 c/s$. It is fount that $3 \cdot 2 \times 10^4 J$ of energy is dissipated as heat in the sample in $30 \min$. If density of iron is $7200 km/m^3$, what is the hysterisis loss?

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238. For a magnetising field of intensity $2 \times 10^3 Am^{-1}$, aluminium at $280K$ acquires intesity of magnetisation of $4 \cdot 8 \times 10^{-2} Am^{-1}$. Find the susceptibility of aluminium at $280K$. If the temperature of the metal is raised to $320K$, what will be its susceptibility and intensity of magnetisation?

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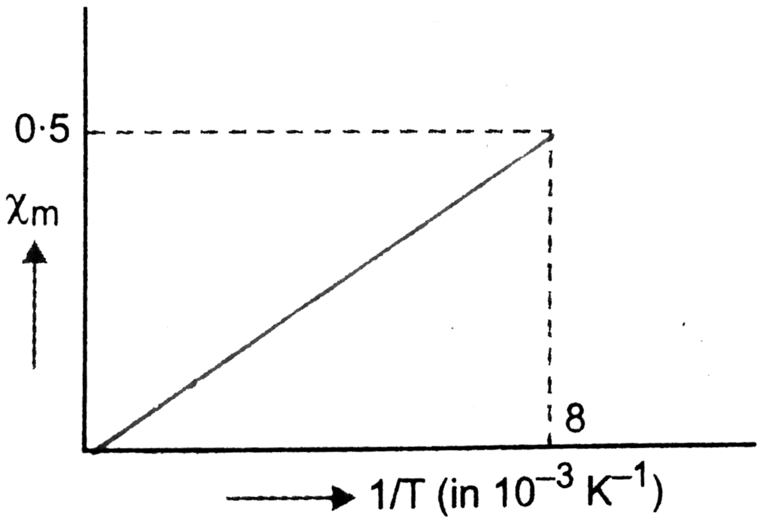
239. Figure shows the variation of susceptibility of a material with $1/T$, where T is the temperature. Calculate curie constant of the material.



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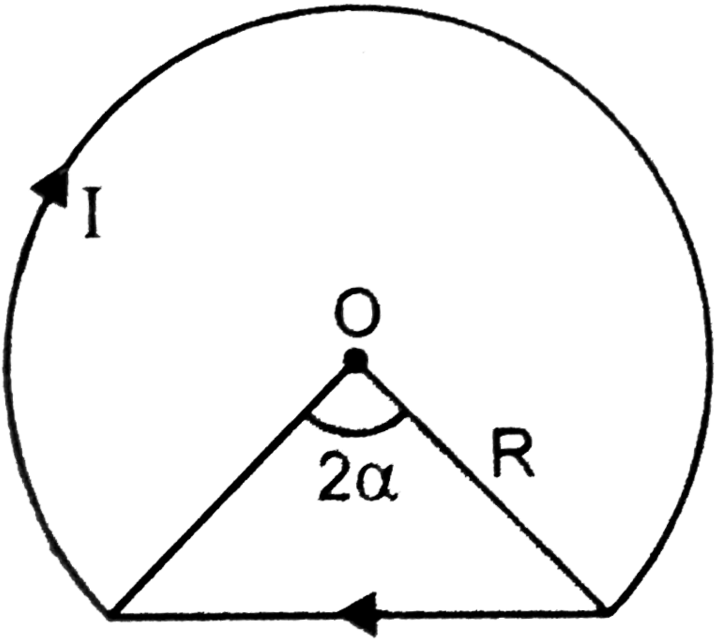
240. An iron rod of volume $10^{-4} m^3$ and relative permeability 1000 is placed inside a long solenoid wound with 5 turns/cm. If a current of $0 \cdot 5A$ is passed through the solenoid, find the magnetic moment of the rod.

Watch Video Solution

241. A bar magnet has pole strength $4 \cdot 5Am$, magnetic length $12cm$ and cross sectional area $0 \cdot 9cm^2$. Find (a) intensity of magnetisation (I) (b) magnetising intesity (H) at the centre and (c) magnetic induction (B) at the centre of the magnet.

Watch Video Solution

242. The magnetic field intensity due to a thin wire carrying current I shown in figure, is



A. $\dfrac{\mu_0 I}{2\pi R}[\pi - \alpha + \tan\alpha]$

B. $\dfrac{\mu_0 I}{2\pi R}[\pi - \alpha]$

C. $\dfrac{\mu_0 I}{2\pi R}[\pi + \alpha]$

D. $\dfrac{\mu_0 I}{2\pi R}[\pi + \alpha - \tan\alpha]$

Answer: A

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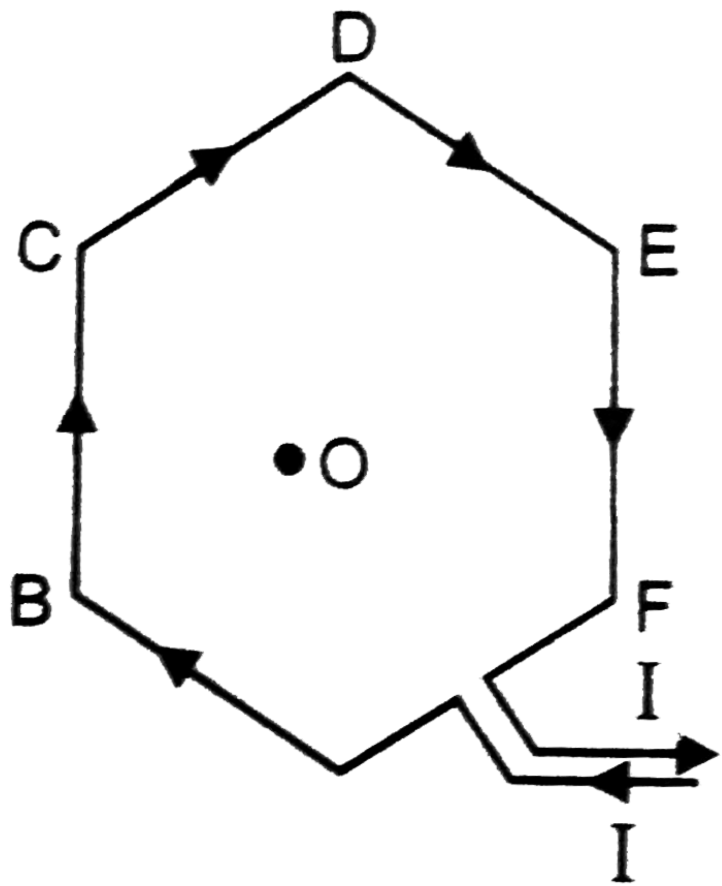
243. A current I is flowing in a hexgonal coil of side a figure. The magnetic field induction at the centre O of the coil will be



A. $\frac{\mu_0 I}{3\sqrt{3}\pi a}$

B. $\frac{\sqrt{3}\mu_0 I}{\pi a}$

C. $\frac{3\sqrt{3}\mu_0 I}{\pi a}$

D. $\frac{\mu_0 I}{\sqrt{3}\pi a}$

Answer: B

Watch Video Solution

244. The current I ampere is flowing in an equilateral triangle of side a the magnetic field induction at the centroid will be

A. $\frac{9\mu_0 I}{2\pi a}$

B. $\frac{5\sqrt{2}\mu_0 I}{3\pi a}$

C. $\frac{3\mu_0 I}{2\pi a}$

D. $\frac{\mu_0 I}{3\sqrt{3}\pi a}$

Answer: A

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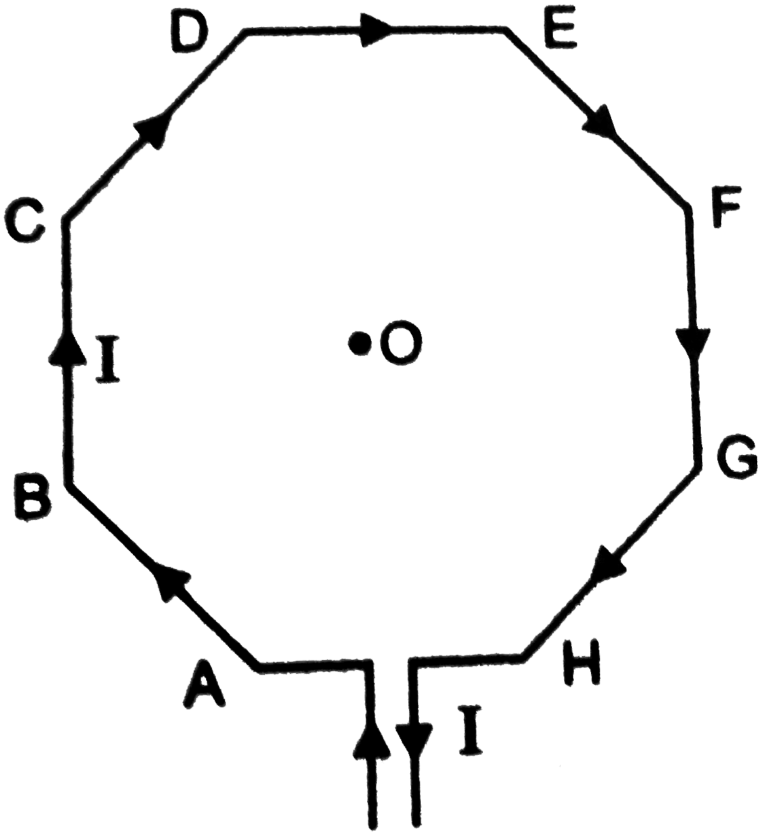
245. A current I is flowing in an octagonal coil of side a figure. The magnetic field induction at the centre O of the coil will be



A. $\dfrac{\sqrt{5}\mu_0 I}{2\pi a}$

B. $\dfrac{\mu_0 I}{\sqrt{5}\pi a}$

C. $\dfrac{5\sqrt{2}\mu_0 I}{\pi a}$

D. $\dfrac{5\mu_0 I}{4\pi a}$

Answer: D

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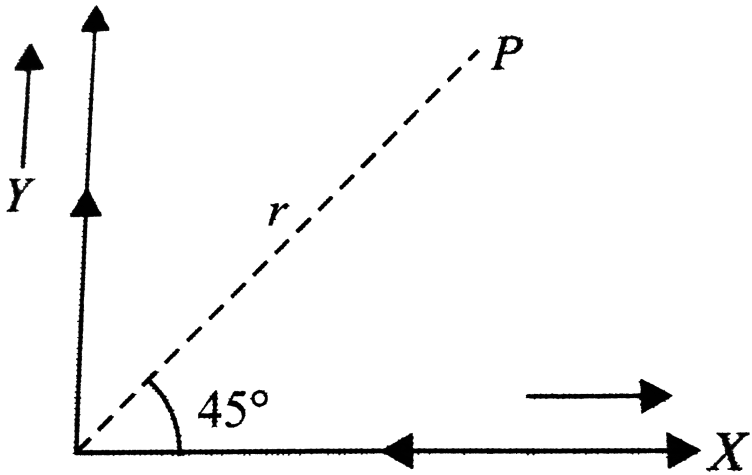
246. Current I flows through a long conducting wire bent at right angle as shown in Fig. Find the magnetic field at point P on the right angle bisector of the angle XOY at distance r form O.



A. $\frac{\mu_0 I}{\pi r}$

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

C. $\frac{\mu_0 I}{4\pi r}\left(\sqrt{2}+1\right)$

D. $\frac{\mu_0}{4\pi}\frac{2I}{r}\left(\sqrt{2}+1\right)$

Answer: D

Watch Video Solution

247. Two identical conducting wires AOB and COD are placed at right angles to each other. The wire AOB carries an electric current I_1 and COD carries a current I_2. The magnetic field on a point lying at a distance d from O, in a direction perpendicular to the plane of the wires AOB and COD, will be given by

A. $\dfrac{\mu_0}{2\pi d}\left(\dfrac{I_1}{I_2}\right)$

B. $\dfrac{\mu_0}{2\pi d}\left(I_1 + I_2\right)$

C. $\dfrac{\mu_0}{2\pi d}\left(I_1^2 - I_2^2\right)$

D. $\dfrac{\mu_0}{2\pi d}\left(I_1^2 + I_2^2\right)^{1/2}$

Answer: D

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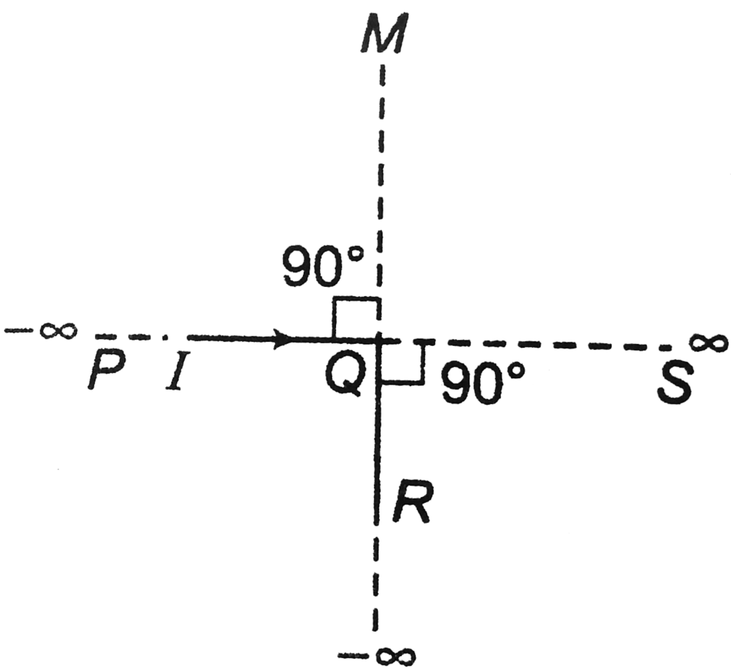
248. An infifnitely long conductor PQR is bent to form a right angle as shown in figure. A current I flows through PQR. The magnetic field due to this current at the point M is H_1 Now, another infinitely long straight conductor QS is connected at Q, so that current is $\frac{I}{2}$ in QR as well as in QS, the current in PQ remaining unchanged. The magnetic field at M is now H_2. The ratio $\frac{H_1}{H_2}$ is given by `



A. $1/2$

B. 1

C. $2/3$

D. 2

Answer: C

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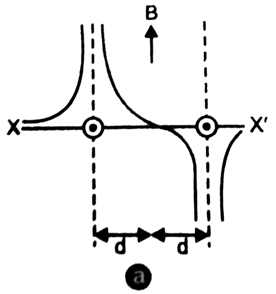
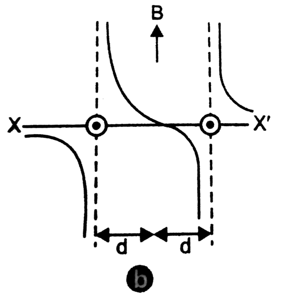
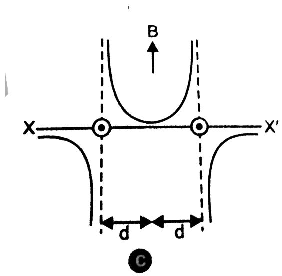
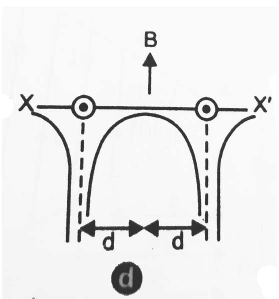
249. Two long parallel wires are at a distance $2d$ apart. They carry steady equal currents flowing out of the plane of the paper , as shown. The variation of the magnetic field B along the line XX is given by

A. 

B. 

C. 

D. 

Answer: B

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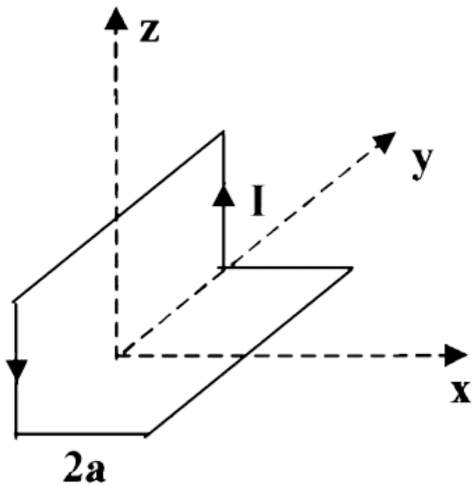
250. A non - popular loop of conducting wire carrying a current I is placed as shown in the figure . Each of the straighrt sections of the loop is of the length $2a$. The magnetic field due to this loop at the point $P(a, 0, a)$ points in the direction



A. $\frac{1}{\sqrt{2}}\left(-\hat{j}+\hat{k}\right)$

B. $\frac{1}{\sqrt{3}}\left(-\hat{j}+\hat{k}+\hat{i}\right)$

C. $\frac{1}{\sqrt{3}}\left(\hat{i}+\hat{j}+\hat{k}\right)$

D. $\frac{1}{\sqrt{2}}\left(\hat{i}+\hat{k}\right)$

Answer: D

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

A. $\frac{\mu_0 I\left(y\hat{i} - x\hat{j}\right)}{2\pi\left(x^2+y^2\right)}$

B. $\frac{\mu_0 I\left(x\hat{i} + y\hat{j}\right)}{2\pi\left(x^2+y^2\right)}$

C. $\frac{\mu_0 I\left(x\hat{j} - y\hat{i}\right)}{2\pi\left(x^2+y^2\right)}$

D. $\dfrac{\mu_0 I\left(x\hat{j} + y\hat{i}\right)}{2\pi\left(x^2 + y^2\right)}$

Answer: A

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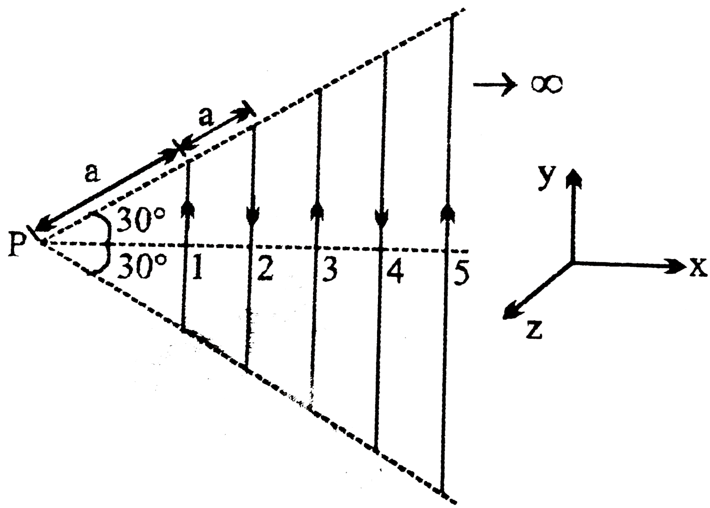
252. Infinite number of straight wires each carrying current I are equally placed as shown in the figure Adjacent wires have current in opposite direction Net magnetic field at point P is



A. Zero

B. $\frac{\mu_0 I}{8\pi} \frac{\log_e 2}{r\sqrt{3}}$

C. $\frac{\mu_0 I}{4\pi} \frac{\log_e 2}{r\sqrt{3}}$

D. $\frac{\mu_0 I}{2\pi} \frac{\log_e 2}{r\sqrt{3}}$

Answer: D

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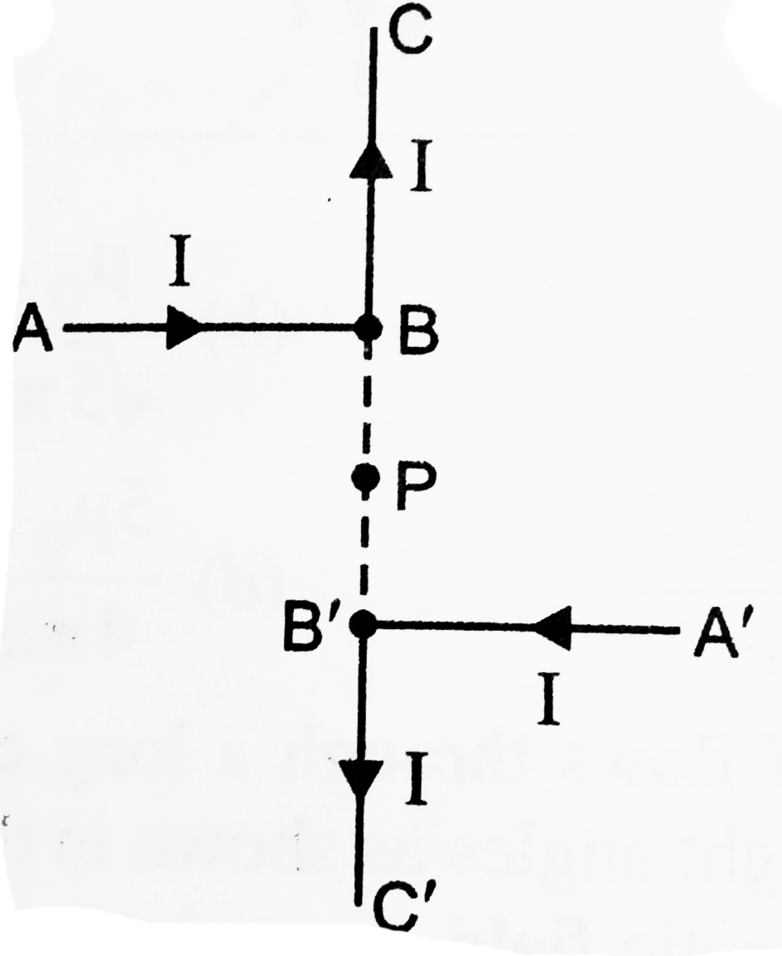
253. Currents through ABC and $A'B'C'$ is I, figure. What is the magnetic field at P? $BP = PB' = r$. (Here $C'B'PBC$ are collinear)



A. $\frac{2I}{4\pi r}$

B. $\frac{\mu_0}{4\pi}\left(\frac{2I}{r}\right)$

C. $\frac{\mu_0}{4\pi}\left(\frac{1}{r}\right)$

D. zero

Answer: B

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254. The magnetic field at the point of intersection of diagonals of a square wire loop of side L, carrying a current I is

A. $\dfrac{\mu_0 I}{\pi L}$

B. $\dfrac{2\mu_0 I}{\pi L}$

C. $\dfrac{\sqrt{2}\mu_0 I}{\pi L}$

D. $\dfrac{2\sqrt{2}\mu_0 I}{\pi L}$

Answer: D

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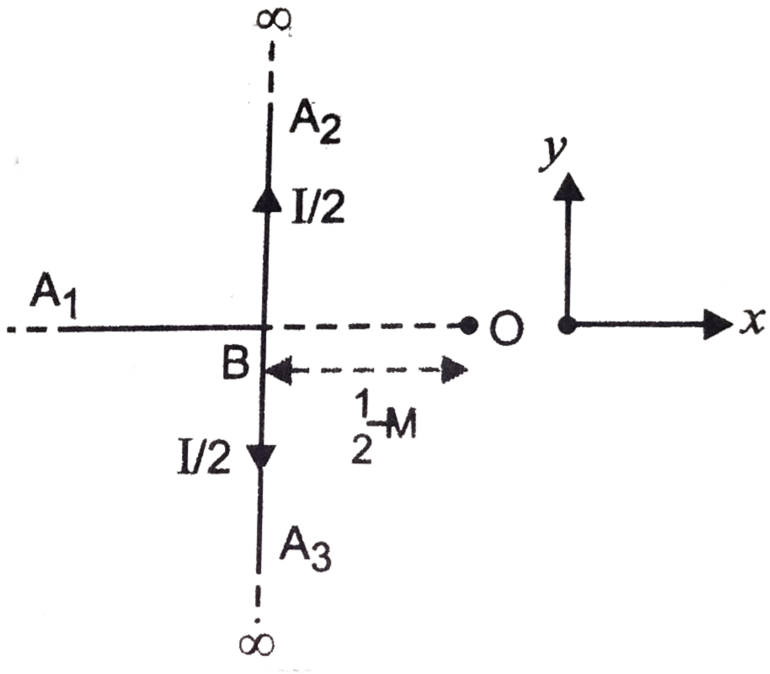
255. A current $I = IA$ flowing through an infinite long wire A_1 divides between two infinite long wires A_2 and A_3 at junction B. The magnitude of the magnetic field at point O due to current through wires is :



A. zero

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

C. $4 \times 10^{-7} T$

D. $8 \times 10^{-7} T$

Answer: A

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

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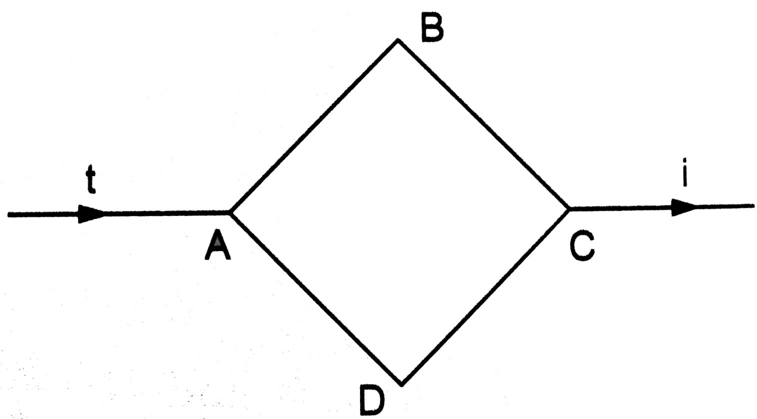

A. $\dfrac{2\mu_0 I}{\pi r}$

B. $\frac{\sqrt{2}\mu_0 I}{\pi r}$

C. $\frac{\sqrt{2}\mu_0 I}{3\pi r}$

D. $\frac{2\mu_0 I}{3\pi r}$

Answer: C

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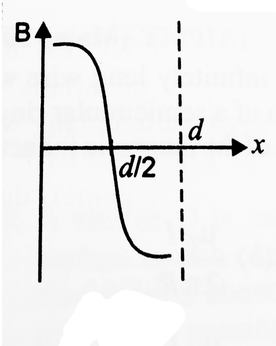
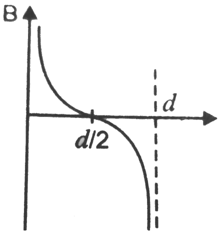
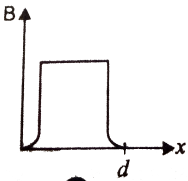
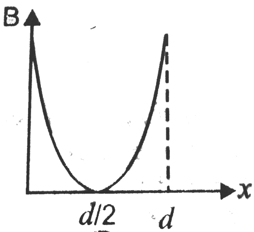
257. Two parallel beams of protons and electrons, carrying equal currents are fixed at a separation d. The protons and electrons move in opposite directions. There is a point P on the straight perpendicular line joining the two beams at a distance x from one beam. The magnetic field at this point is B. If B is plotted against x, it can be represented by the curve.

A. 

B. 

C. 

D. 

Answer: B

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258. Two parallel wires in the plane of the paper are distance X_0 apart. A point charge is moving with speed u between the wires in the same plane at a distance X_1 from one of the wires. When the wires carry current of magnitude I in the same direction , the radfius of curvature of the path of the point charge is R_1. In contrast, if the currentsd I in the two wires have directions opposite to each other, the radius of curvature of the path is R_2. if $\frac{X_0}{X_1} = 3$, the value of $\frac{R_1}{R_2}$ is

A. 1

B. 2

C. 3

D. 4

Answer: C

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

A. zero

B. $\frac{\mu_0 n^2 e}{r}$

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

D. $\frac{\mu_0 \text{ne}}{2\pi r}$

Answer: C

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260. Two identical wires A and B, each of length 'l', carry the same current I. Wire A is bent into a circle of radius R and $wire B$ is bent to form a square of side 'a' . If B_A and B_B are the values of magnetic field at the centres of the circle and square respectively, then the ratio $\frac{B_A}{B_B}$ is :

A. $\pi^2/8$

B. $\pi^2/16\sqrt{2}$

C. $\pi^2/16$

D. $\pi^2/8\sqrt{2}$

Answer: D

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261. Charge q is uniformly distributed on a disc of radius r. If the disc is rotated with a frequency v, then magnetic field induction at the centre will be

A. $\frac{\mu_0 q}{vr}$

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

C. $\frac{\mu_0 v}{qr}$

D. $\frac{\mu_0}{qvr}$

Answer: B

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262. Two similar coils of radius R are lying concentriclaly with their planes at right angels to each other. The currents flowing in them are I and $2I$ respectively. The resulant magntic field induction at the centre will be

A. $\frac{\sqrt{5}\mu_0 I}{2R}$

B. $\frac{3\mu_0 I}{2R}$

C. $\frac{\mu_0 I}{2R}$

D. $\frac{\mu_0 I}{R}$

Answer: A

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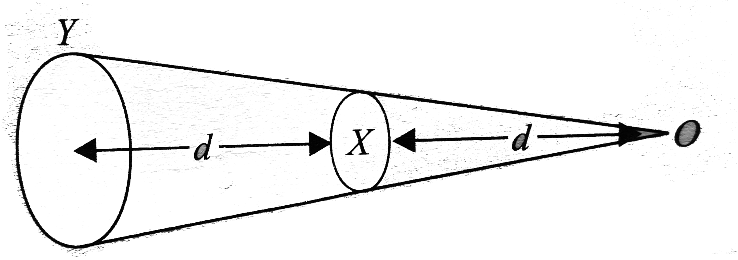
263. Two circular coils X and Y, having equal number of turns and carrying currents in the same sense, subtend same solid angle at point O. If the smaller coil X is midway between O and Y and if we represent the magnetic induction due to bigger coil Y at O as B_y

and the due to smaller coil X at O as B_x,then find the ratio B_x / B_y.



A. $1:1$

B. $2:1$

C. $1:2$

D. $1:4$

Answer: C

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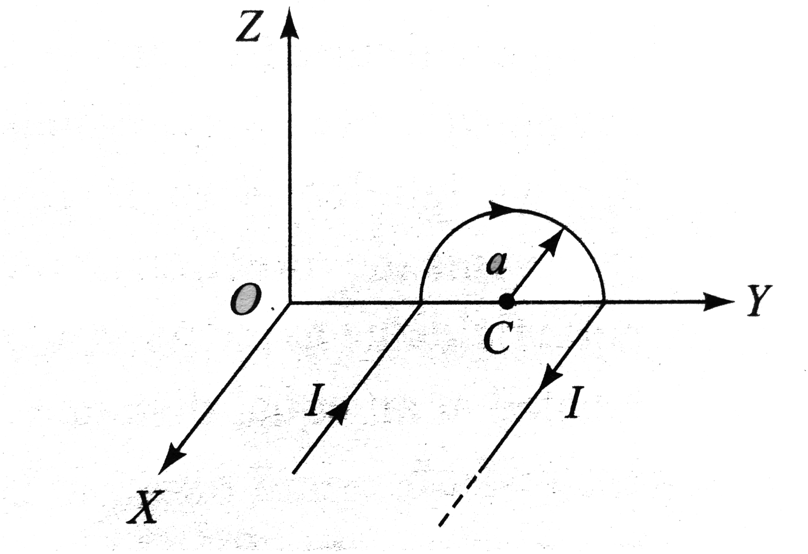
264. A long wire bent as shown in fig. carries current I. If the radius

of the semicircular portion is a, the magnetic field at centre C is



A. $\dfrac{\mu_0 I}{4r}$

B. $\dfrac{\mu_0 I}{4\pi r}\sqrt{\pi^2 + 4}$

C. $\dfrac{\mu_0 I}{4\pi} + \dfrac{\mu_0 I}{2\pi r}$

D. $\dfrac{\mu_0 I}{4\pi r}\sqrt{\pi^2 - 4}$

Answer: B

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265. Two similar coils of radius R and number of turns N are lying concentrically with their planes at an angle 60° to each other. The currents flowing in them are I and 2I respectively. The resultant magnetic induction at the centre will be

A. $\frac{\mu_0 NI}{R}$

B. $\frac{\sqrt{3}\mu_0 NI}{2R}$

C. $\frac{\sqrt{5}\mu_0 NI}{2R}$

D. $\frac{\sqrt{7}\mu_0 NI}{2R}$

Answer: D

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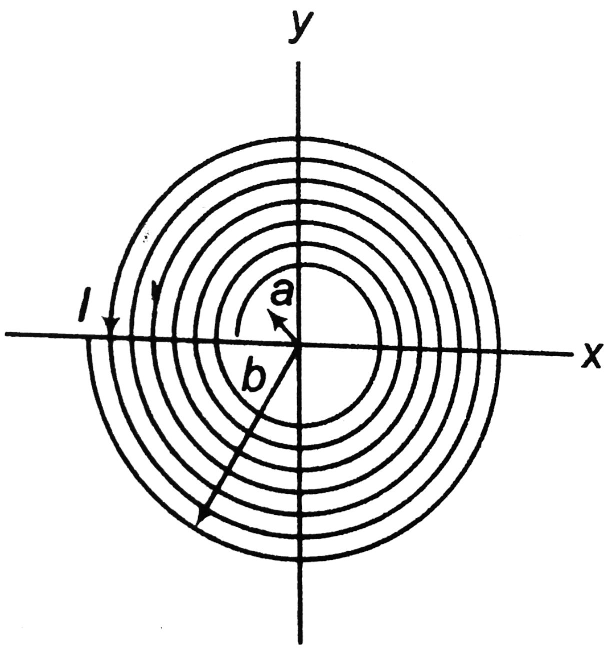
266. A long insulated copper wire is closely wound as a spiral of N turns. The spiral has inner radius a and outer radius b. The spiral lies in the xy-plane and a steady current I flows through the wire.

The$z$-component of the magetic field at the centre of the spiral is



A. $\frac{\mu_0 nI}{(b - a)}\left(\log_e\right)\frac{a}{b}$

B. $\frac{\mu_0 nI}{2(b - a)}$

C. $\frac{2\mu_0 nI}{b}$

D. $\frac{\mu_0 nI}{2(b - a)}\left(\log_e\right)\frac{b}{a}$

Answer: D

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267. A current loop consists of two identical semicircular parts each of radius R, one lying in the x-y plane and the other in x-y plane. If the current in the loop is i, the resultant magnetic field due to two semicircular parts at their common centre is

A. $\frac{\mu_0 i}{2\sqrt{2}R}$

B. $\frac{\mu_0 i}{2R}$

C. $\frac{\mu_0 i}{4R}$

D. $\frac{\mu_0 i}{\sqrt{2}R}$

Answer: A

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268. A current I flows an infinitely long wire with cross section in the form of a semi - circular ring of radius R. The magnitude of the magnetic induction along its axis is :

A. $\frac{\mu_0 I}{2\pi^2 R}$

B. $\frac{\mu_0 I}{2\pi R}$

C. $\frac{\mu_0 I}{4\pi^2 R}$

D. $\frac{\mu_0 I}{\pi^2 R}$

Answer: D

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269. A battery is connected between two points A and B on the circumference of a uniform conducting ring of radius r and resistance R . One of the arcs AB of the ring subtends an angle θ at the centre . The value of the magnetic induction at the centre due to the current in the ring is

A. proportional to 2 $\left(180^{\circ} - \theta\right)$

B. inversely proportional to r

C. zero, only if $\theta = 180^{\circ}$

D. zero for all values of θ.

Answer: D

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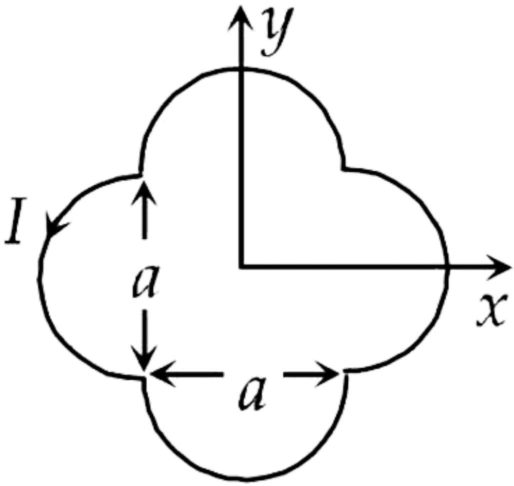
270. A loop carrying current I lies in the x - y plane as shown in the figure . The unit vector $\hat{k}$ is coming out of the plane of the paper .

The magnetic moment of the current loop is



A. $a^2 I\hat{k}$

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

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

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

Answer: B

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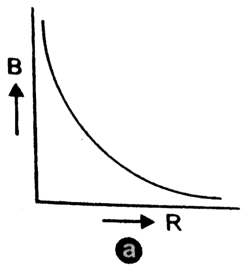
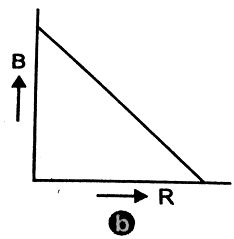
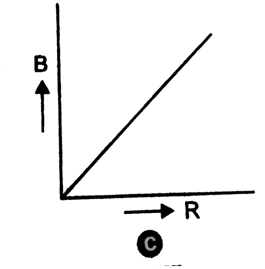
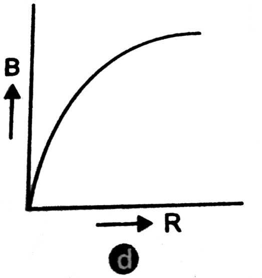
271. A charge Q is uniformly distributed over the surface of non - conducting disc of radius R. The disc rotates about an axis perpendicular to its plane and passing through its centre with an angular to its plane and passing through its centre of the disc. If we keep both the amount of charge placed on the disc and its angular velocity to be constant and vary the radius of the disc then the variation of the magnetic induction at the centre of the disc will br represented by the figure:

A. 

B. 

C. 

D. 

Answer: A

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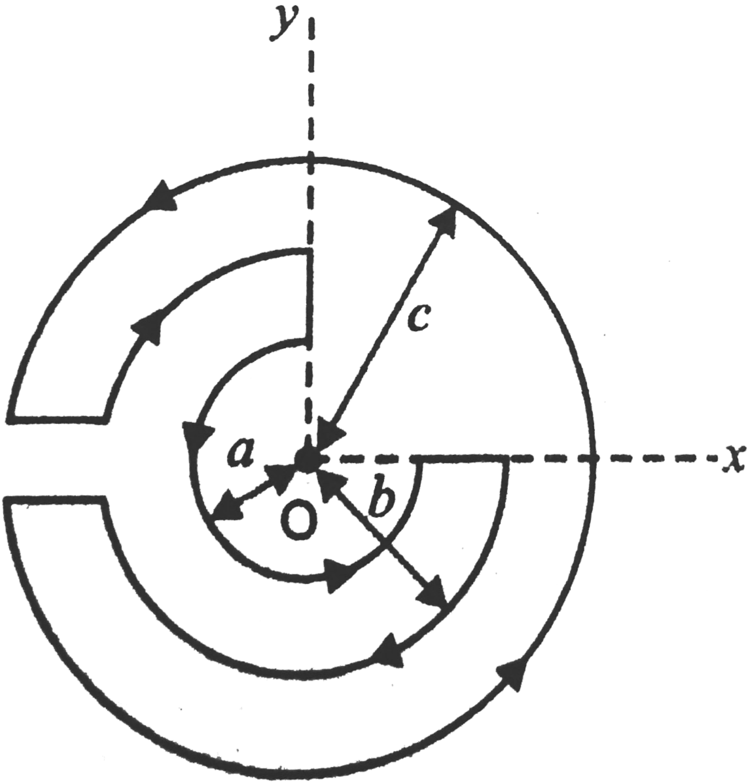
272. Refer to figure, where $c = 3a$ and $a < b < c$, the magnetic field induction at point O will be zero due to current I in the various portion of the network when



A. $b = \frac{5}{7}a$

B. $b = \frac{7a}{9}$

C. $b = \frac{9a}{13}$

D. $b = \frac{13a}{15}$

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273. A long straight wire of radius a carries a steady current i. The current is uniformly distributed across its cross section. The ratio of the magnetis field at $(a)/(2)$ and $(2a)$ is

A. $1/2$

B. $1/4$

C. 4

D. 1

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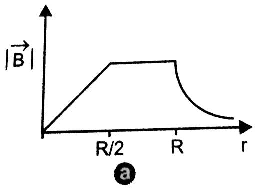
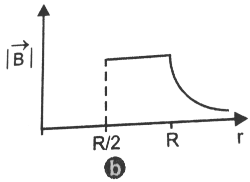
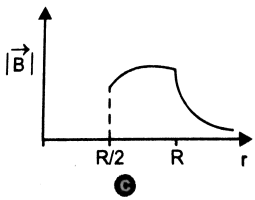
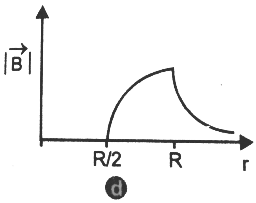
274. An infinitely long hollow conducting cylinder with inner radius $\frac{r}{2}$ and outer radius R carries a uniform current ra density along its length . The magnitude of the magnetic field , $|\vec{B}|$ as a function of the radial distance r from the axis is best represented by

A. 

B. 

C. 

D. 

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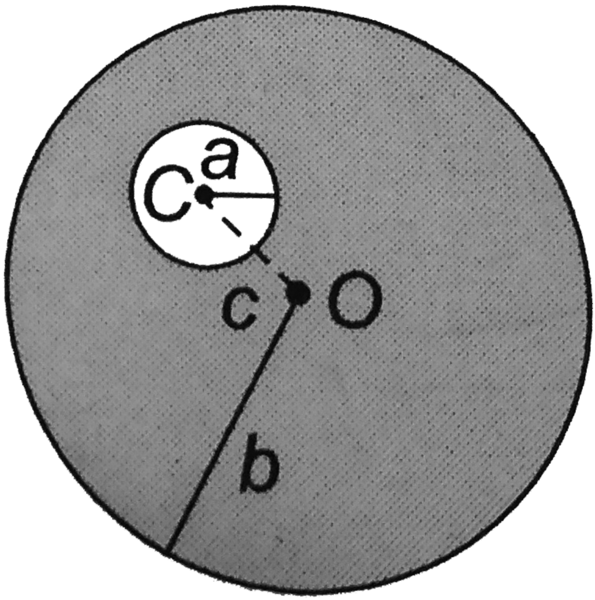
275. A long straight metal rod has a very long hole of radius $'a'$ drilled parallel to the rod axis as shown in the figure. If the rod carries a current I, find the magnetic field on axis of hole. Given C is the centre of the hole and $OC = c$.



A. $\dfrac{\mu_0 Ir}{4\pi\left(r_2^2 - r_1^2\right)}$

B. $\dfrac{\mu_0 Ir}{2\pi\left(r_2^2 - r_1^2\right)}$

C. $\frac{\mu_0 Ir}{\pi\left(r_2^2 - r_1^2\right)}$

D. $\frac{\mu_0 Ir}{6\pi\left(r_2^2 - r_1^2\right)}$

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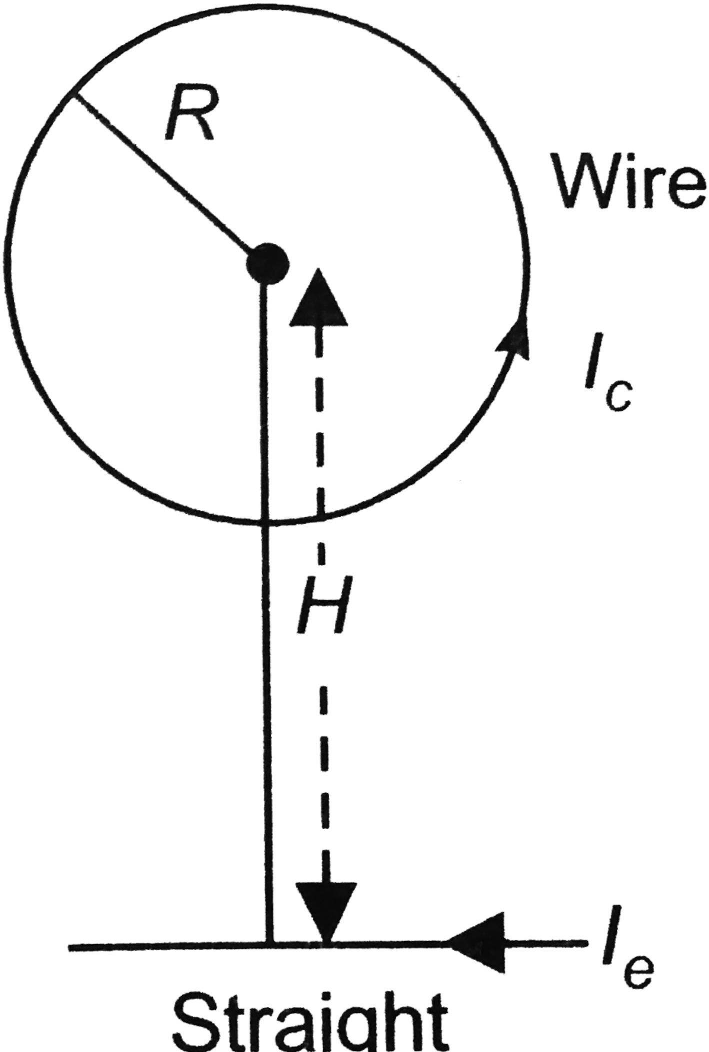
276. Circular loop of a wire and a long straight wire carry current I_c and $I_e$respectively as shown in figure. Assuming that these are placed in the same plane. The magnetic field will be zero at the centre of the loop when the separation H is:



A. $\frac{I_l R}{I_c \pi}$

B. $\frac{I_c R}{I_l \pi}$

C. $\frac{I_c \pi}{I_l R}$

D. $\frac{I_l \pi}{I_c R}$

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

A. 8 N in z-direction

B. 8 N in -z-direction

C. 4N in z-direction

D. 8N in y-direction

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278. A proton carrying $1MeV$ kinetic energy is moving in a circular path of radius R in unifrom magentic field. What should be the energy of an α - particle to describe a circle of the same radius in the same field?

A. $2MeV$

B. $1MeV$

C. $0 \cdot 5MeV$

D. $4MeV$

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279. 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 X-direction

B. a circle in the X-Z plane

C. a circle in the YZ plane

D. a circle in the XY plane

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

A. $\vec{E} \mid \mid \vec{B}$ but $\vec{v}$ is not parallel to $\vec{E}$

B. $\vec{v} \mid \mid \vec{B}$ but $\vec{E}$ is not parallel to $\vec{B}$

C. $\vec{E} \mid \mid \vec{B}, \vec{v} \mid \mid \vec{E}$

D. $\vec{E}$ is not parallel to $\vec{B}$ and $\vec{v}$.

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281. Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2, respectively. The ratio of masses of X and Y is

A. $\dfrac{R_1}{R_2}$

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

C. $\left(\dfrac{R_1}{R_2}\right)^{1/2}$

D. $\left(\dfrac{R_1}{R_2}\right)^{2}$

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282. A proton and an alpha particle both enters a region of uniform magnetic field B, moving at right angles to the field B. If the radius of circular orbits for both the particles is equal and the kinetic energy acquired by proton is $1MeV$, the energy acquired by the alpha particles will be :

A. $1MeV$

B. $4MeV$

C. $0 \cdot 5MeV$

D. $1 \cdot 5MeV$

Answer: A

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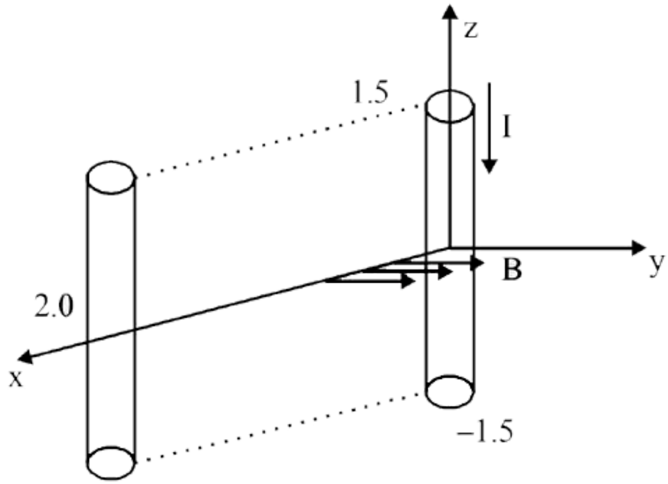
283. A conductor lies along the z-axis at $-1.5 \le z < 1.5m$ and carries a fixed current of $10.0A$ in $-\hat{a}_z$ direction (see figure). For a field

$\vec{B} = 3.0 \times 10^{-4} e^{-0.2x} \hat{a}_y T$, find the power required to move the conductor at constant speed to $x = 2.0m, y = 0m$ in $5 \times 10^{-3} s$.

Assume parallel motion along the x - $a\xi s$.



A. $14 \cdot 85W$

B. $29 \cdot 7W$

C. $1 \cdot 57W$

D. $2 \cdot 97W$

Answer: D

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284. A particle of mass m and charge q is accelerated through a potential differece V to a velocity $\vec{v}$ towards south. The particle enters a region with both a magnetic field $\vec{B}$ (pointing eastwards) and electric field $\vec{E}$ (pointing downwards). The particle travels with a constant velocity through this region. The potential difference V through this region should be equal to

A. E/B

B. E/qB

C. $2mE/qB$

D. $mE^2/2qB^2$

Answer: D

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285. An electric charge $+q$ moves with velocity $\vec{v} = 3\hat{i} + 4\hat{j} + \hat{k}$, in an electromagnetic field given by $\vec{E} = 3\hat{i} + \hat{j} + 2\hat{k}$, $\vec{B} = \hat{i} + \hat{j} - 3\hat{k}$. The y-component of the force experienced by +q is

A. $2q$

B. $11q$

C. $5q$

D. $3q$

Answer: B

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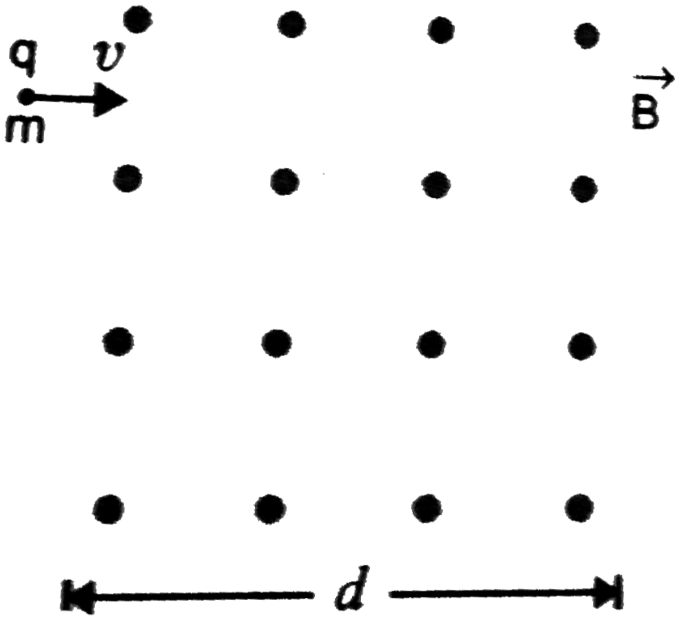
286. A charged particle of mass m and charge q is projected into a uniform magnetic field of induciton $\vec{B}$ with speed v which is perpendicular to $\vec{B}$. The width of the magnetic field is d. The impulse imparted to the particle by the field is $(d < < mv/qB)$



A. qBd

B. qBv/d

C. $mv/(qBd)$

D. $mv^2/(qBd)$

Answer: A

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

A. a circle of radius $0 \cdot 2m$ and time period $\pi \times 10^{-7} s$

B. a circle of radius $= 0 \cdot 1m$ and time period $2\pi \times 10^{-7} s$

C. a helix of radius $= 0 \cdot 1m$ and time period $2\pi \times 10^{-7} s$

D. a helix of radius $= 0 \cdot 2m$ and time period $4\pi \times 10^{-7} s$

Answer: C

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288. A particle of the mass m and cgharge q moves with a constant velocity v along the positive x- direction . It enters a region containing a uniform magnetic field B directed along the minimum value of v required so that the particle can just enter the region $x > b$ is

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

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

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

D. $\dfrac{q(b + a)B}{2m}$

Answer: B

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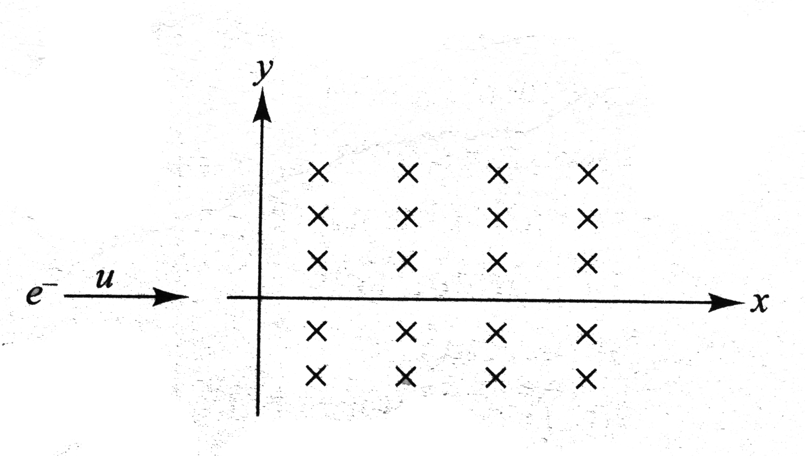
289. An electron moving with a speed u along the positive x-axis at $y = 0$ enters a region of uniform magnetic field which exists to the right of y-axis. The electron exits from the region after some time with the speed v at coordinate y, then



A. $v > u, y < 0$

B. $v = u, y > 0$

C. $v > u, y > 0$

D. $v = u, y > 0$

Answer: D

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290. A charged particle with charge q enters a region of constant, uniform and mututally orthogonal fields $\vec{E}$ and $\vec{B}$ with a velocity $\vec{v}$ perpendicular to both $\vec{E}$ and $\vec{B}$, and comes out without any change in magnitude or direction of $\vec{v}$. Then

A. $\vec{v} = \vec{B} \times \vec{E} / E^2$

B. $\vec{v} = \vec{E} \times \vec{B} / B^2$

C. $\vec{v} = \vec{B} \times \vec{E} / B^2$

D. $\vec{v} = \vec{E} \times \vec{B} / E^2$

Answer: B

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291. Two large vertical and parallel metal plates having a separation of 1cm are connected to a DC voltage source of potential difference X. A proton is released at rest midway between the two plates. It is found to move at 45° to the vertical JUST after release. Then X is nearly

A. $1 \times 10^{-5} V$

B. $1 \times 10^{-7} V$

C. $1 \times 10^{-9} V$

D. $1 \times 10^{-10} V$

Answer: C

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292. Proton , deuton and alpha particle of same kinetic energy are moving in circular trajectories in a constant magnetic field. The radii of proton , deuteron and alpha particle are respectively r_p, r_d and r_α. Which one of the following relation is correct?

A. $r_\alpha = r_p = r_d$

B. $r_\alpha = r_p < r_d$

C. $r_\alpha > r_d > r_p$

D. $r_\alpha = r_d > r_p$

Answer: B

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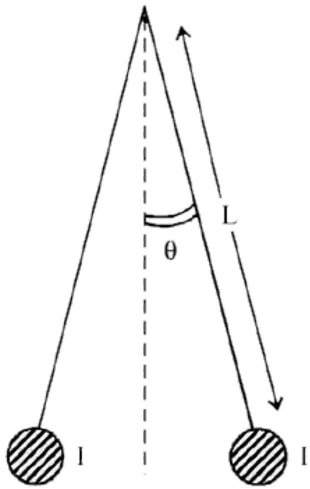
293. Two long current carrying thin wires , both with current I, are held by insulating threads of length L and are in equilibrium as shown in the gigure , With threads making an angle θ with the vertical . If wires have mass λ per unit length then the value of I is :



A. $\sin\theta\sqrt{\dfrac{\pi\lambda gL}{\mu_0\cos\theta}}$

B. $2\sin\theta\sqrt{\dfrac{\pi\lambda gL}{\mu_0\cos\theta}}$

C. $2\sqrt{\dfrac{\pi gL}{\mu_0}\tan\theta}$

D. $\sqrt{\dfrac{\pi\lambda gL}{\mu_0}\tan\theta}$

Answer: B

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294. when a proton is released from rest in a room, it starts with an initital acceleration a_0 towards west . When it is projected towards north with a speed v_0, it moves with an initial acceleration $3a_0$ towards west. Find the elecrtic field and the minimum possible magnetic field in the room.

A. $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_0}$ down

B. $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ up

C. $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ down

D. $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_0}$ up

Answer: C

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295. An electron of mass M_e, initially at rest, moves through a certain distance in a uniform electric field in time t_1. A proton of mass M_p also initially at rest, takes time t_2 to move through an equal distance in this uniform electric field. Neglecting the effect of gravity, the ratio t_2/t_1 is nearly equal to

A. 1

B. $\sqrt{\frac{M_p}{M_e}}$

C. $\sqrt{\frac{M_e}{M_p}}$

D. 1836

Answer: B

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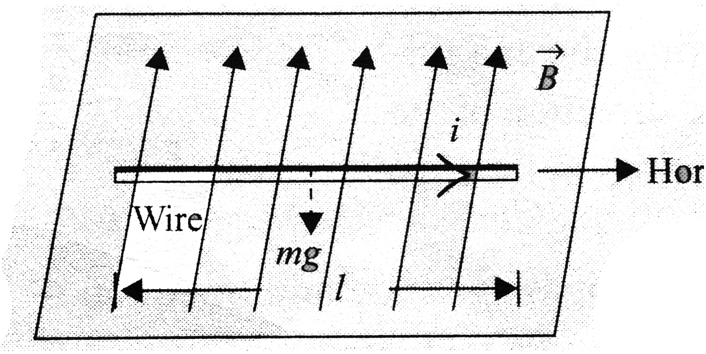
296. A straight wire of mass 200 g and length 1.5 m carries a current of 2 A. It is suspended in mid-air by a uniform horizontal magnetic field B. What is the magnitude of the magnetic field?



A. 2

B. $1 \cdot 5$

C. $0 \cdot 55$

D. $0 \cdot 65$

Answer: D

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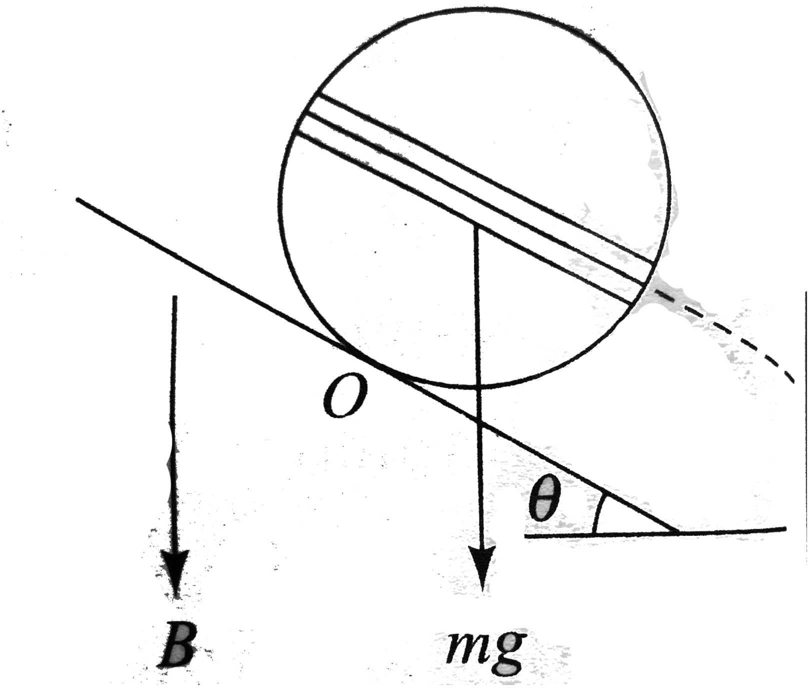
297. In Fig. a coil of single turn is wound on a sphere of radius r and mass m. The plane of the coil is parallel to the inclined plane and lies in the equatorial plane of the sphere. If the sphere is in rotational equilibrium, the value of B is [Current in the coil is i]



A. $mg\cos\theta/(\pi IR)$

B. $mg/\pi IR$

C. $m > an\theta/\pi IR$

D. $mg\sin\theta/\pi IR$

Answer: B

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298. An electric current runs counter clockwise in a rectangular loop around the outside edge of this page, which lies flat on your table. A uniform magnetic field is then turned on, directed parallel to the page from top to bottom, the magnetic force on the page will cause

A. the bottom edge to lift

B. the top edge to lift

C. the left edge to lift

D. the right edge to lift

Answer: B

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

A. $6 \times 10^{-3} T$, acting vertically upwards

B. $6 \times 10^{-3} T$, acting horizontally perpendicular to wire

C. $6 \times 10^{-2} T$, acting vertically downwards

D. $6 \times 10^{-2} T$, acting horizontally perpendicular to wire

Answer: B

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300. A horizontal rod of mass $10g$ and length $10cm$ is placed on a smooth plane inclined at an angle of 60° with the horizontal with the length of the rod parallel to the edge of the inclined plane. A uniform magnetic field induction B is applied vertically downwards. If the current through the rod is $1 \cdot 73 ampere$, the value of B for which the rod remains stationary on the inclined plane is

A. $0 \cdot 5T$

B. $1 \cdot 0T$

C. $1 \cdot 5T$

D. $1 \cdot 7T$

Answer: B

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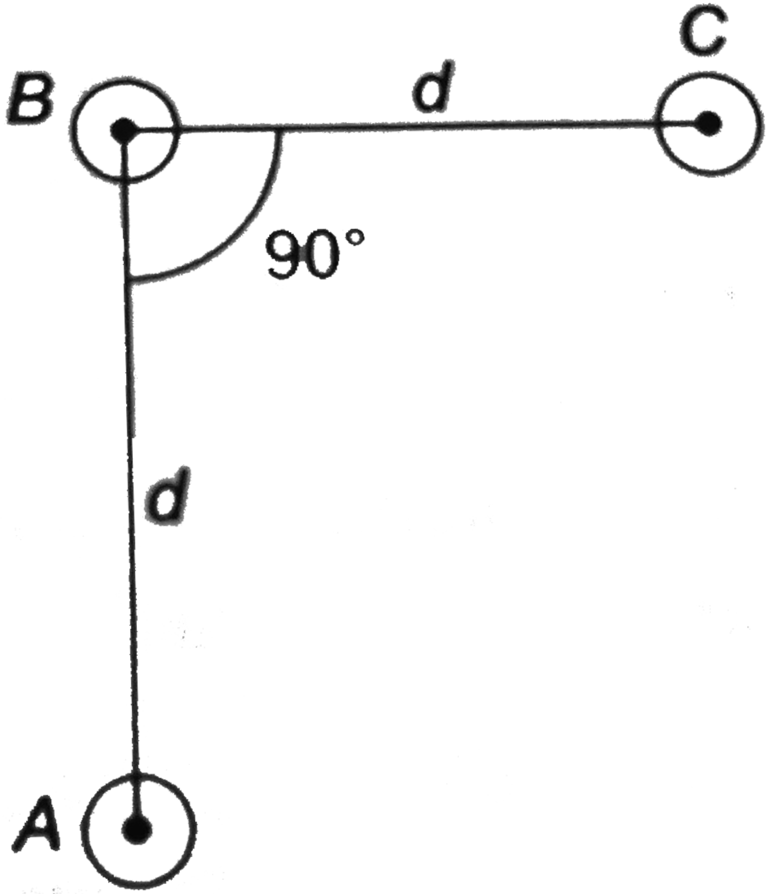
301. An arrangment of three parallel staright wires placed perpendcular to plane of paper carrying same current I along the same direction is shown in figure. Magnitude of force per unit length on the middle wire $'B'$ is given by



A. $\frac{\mu_0 i^2}{2\pi d}$

B. $\frac{2\mu_0 i^2}{\pi d}$

C. $\frac{\sqrt{2}\mu_0 i^2}{\pi d}$

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

Answer: D

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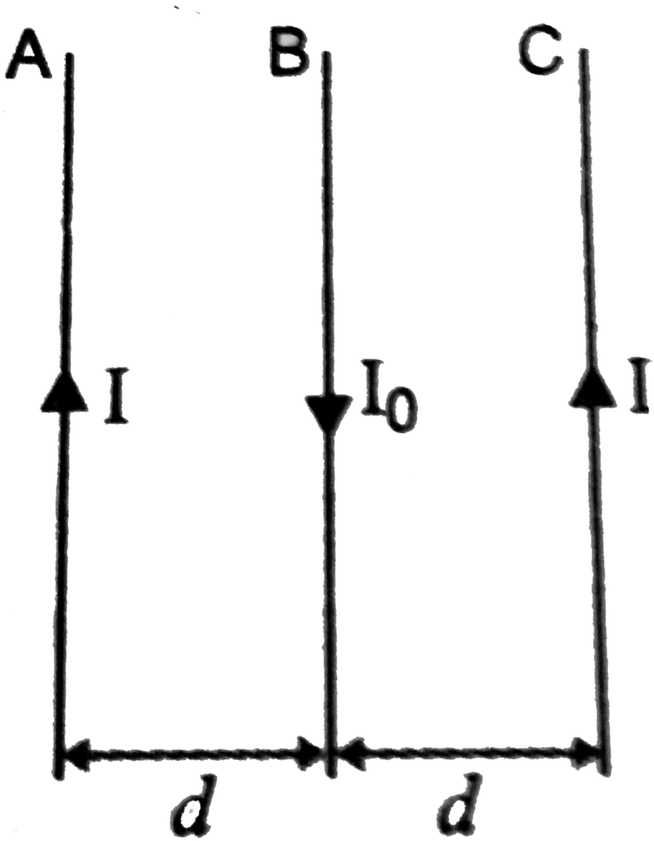
302. Three very long straight current carrying conductors are placed parallel to each other as shown in. The conductors A and C are fixed whereas conductors B is free to move. If the conductor B is pulled towards right through a very small distance r, then what is the net force acting on it and the angular frequency of the resulting oscillation.



A. $\frac{\mu_0 2 I I_0}{\pi d^2}, \sqrt{\frac{\mu_0 I I_0}{\pi m d^2}}$

B. $\frac{\mu_0 2 I I_0}{4\pi r^2}, \sqrt{\frac{\mu_0 I I_0}{2\pi m d^2}}$

C. $\frac{\mu_0 I I_0}{2\pi r^2}, \sqrt{\frac{\mu_0 I I_0}{4\pi m d}}$

D. $\frac{\mu_0 I I_0}{2\pi}\left[\frac{(d+r)-(d-r)}{d^2-r^2}\right], \sqrt{\frac{\mu_0 I I_0}{\pi m d^2}}$

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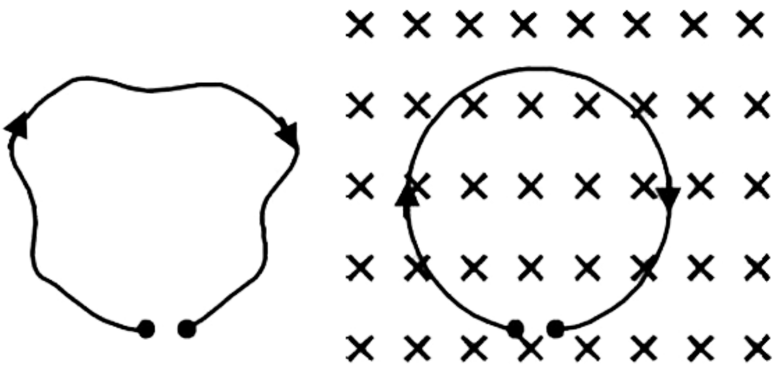
303. A thin wire of length L is connected to two adjacent fixed points and carries a current I in the clockwise direction , as shown in the figure. When the system is put in a uniform magnetic field of strength B going into the plane of the paper , the wire takes the shape of a circle . The tension in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



A. IBL

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

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

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

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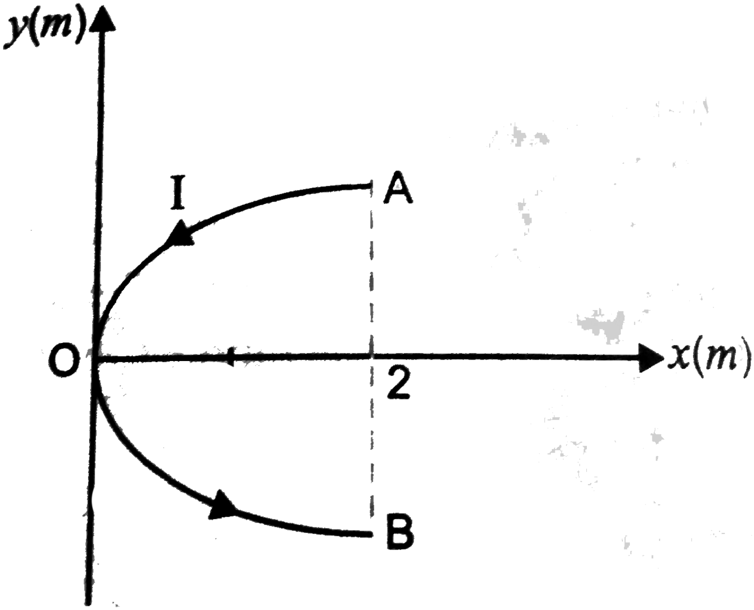
304. A conducting wire bent in the form of a parabola $y^2 = 2x$, carries a current $I = 2A$ as shown in figure. The wire is subjected to a uniform magnetic field $\vec{B} = -2\hat{k}$ tesla. The magnetic force on the wire in (newton) is



A. $-8\hat{i}$

B. $-16\hat{i}$

C. $8\hat{i}$

D. $16\hat{i}$

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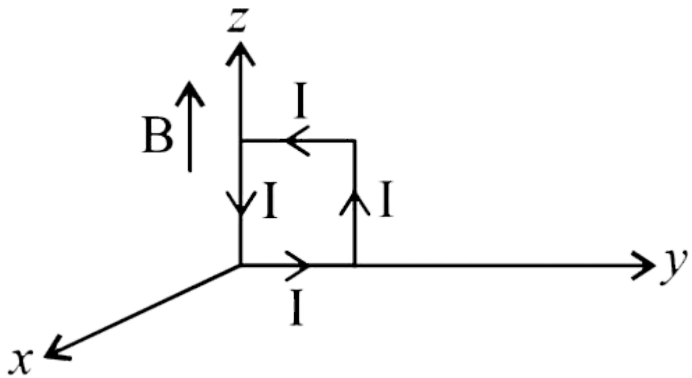
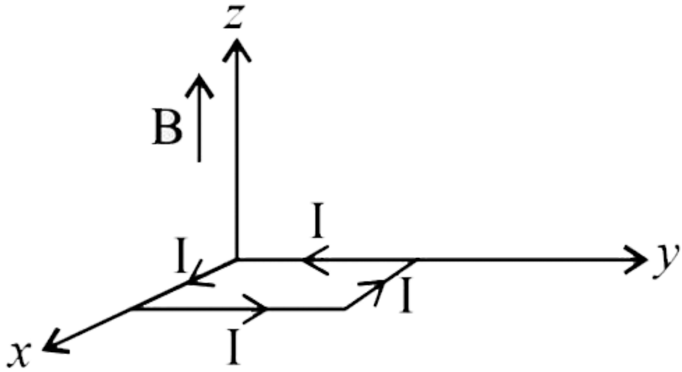
305. A rectangular loop of sides $10cm$ and $5cm$ carrying a current $1of12A$ is placed in different orientations as shown in the figure below:

If there is auniform magnetic field of $0.3t$ in the positive z direction , in which orientations the loop would be in (i) stable equilibrium and (ii) unstable equilibrium ?

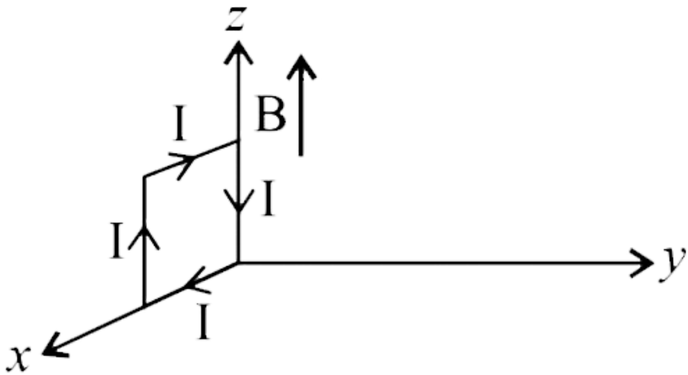
(A)

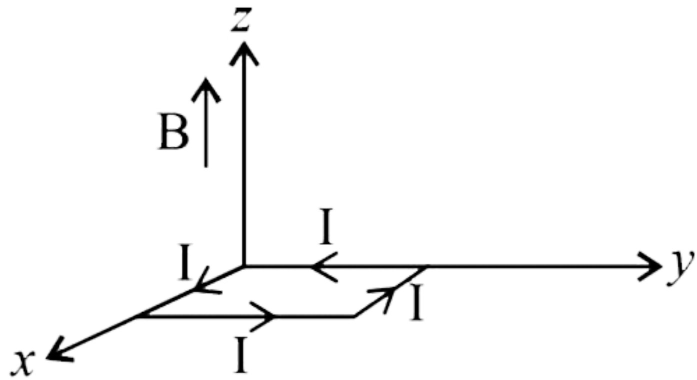


(B)



(C)



(D) 

A. (i) and (ii) respectively

B. (i) and (iii) respectively

C. (ii) and (iv) respectively

D. (ii) and (iii) respectively

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306. A recantagular coil of length $0.12m$ and width $0.1m$ having 50 turns of wire is suspended vertically in unifrom magnetic field of srenght 0.2 $Weber/m^2$. The coil carres a current of 2 A. If the plane of the coil is inclined at an angl,e of 30° with the direction of the feld the torque required to keep the coil in stable equilibrium will be

A. $0 \cdot 12 Nm$

B. $0 \cdot 15 Nm$

C. $0 \cdot 20 Nm$

D. $0 \cdot 24 Nm$

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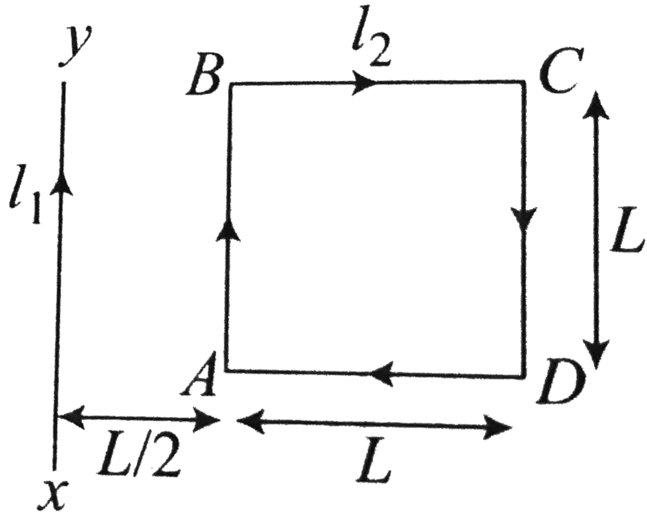
307. A sqaure loop $ABCD$, carrying a current I_2 is placed near and coplanar with a long straight conductor XY, carrying a current I_1

as shwon in Figure. The net force on the loop will be



A. $\frac{2\mu_0 I' I}{3\pi}$

B. $\frac{\mu_0 I' I}{2\pi}$

C. $\frac{2\mu_0 I' IL}{3\pi}$

D. $\frac{\mu_0 I' IL}{2\pi}$

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

A. $\frac{2}{\sqrt{3}}\left(\frac{\tau}{BI}\right)$

B. $2\left(\frac{\tau}{\sqrt{3}BI}\right)^{1/2}$

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

D. $\frac{1}{\sqrt{3}}\left(\frac{\tau}{BI}\right)$

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

A. $q/2$

B. q/m

C. $2q/m$

D. $q/\pi m$

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310. A conducting wire of length l is turned in the form of a circular coil and a current I is passed through it. For the torque, due to magnetic field produced at its centre, to be maximum, the number of turns in the coil will be

A. one

B. two

C. three

D. more than three

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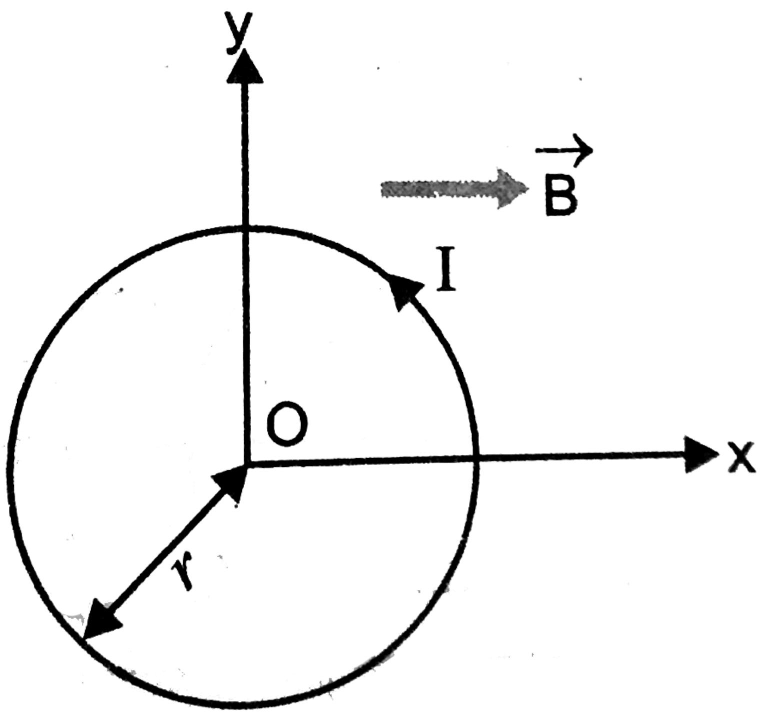
311. A circular loop of mass m and radius r in X-Y plane of a horizontal table as shown in figure. A uniform magnetic field B is applied parallel to X-axis. The current I in the loop, so that its one edge just lifts from the table is



A. $\frac{mg}{\pi rB}$

B. $\frac{mg}{2\pi rB}$

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

D. $\frac{2\pi rB}{mg}$

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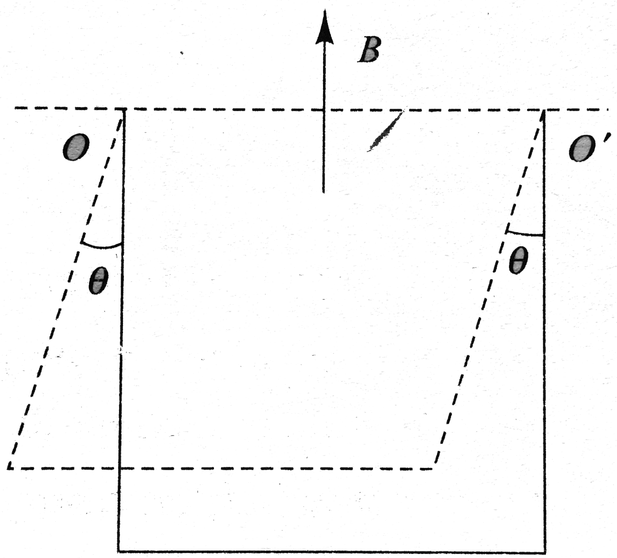
312. A wire of cross-sectional area A forms three sides of a square and is free to rotate about axis OO'. If the structure is deflected by an angle θ from the vertical when current i is passed through it in a magnetic field B acting vertically upward and density of the wire is ρ, then the value of θ is given by



A. $\sin\theta = \dfrac{A\rho g}{IB}$

B. $\cos\theta = \dfrac{A\rho B}{2IB}$

C. $\tan\theta = \frac{2A\rho g}{IB}$

D. $\cot\theta = \frac{2A\rho g}{IB}$

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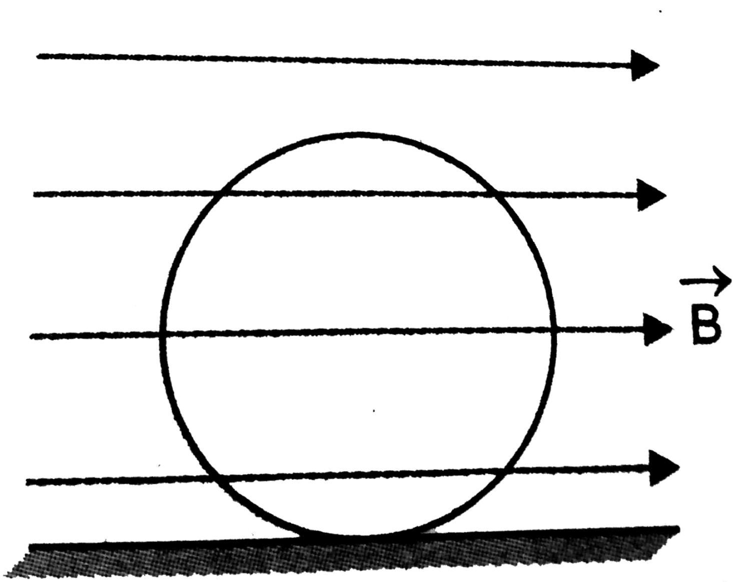
313. A conducting rign of mass 100 gram and radius $0 \cdot 5m$ is placed on a smooth horizontal plane. The ring carries a current of $I = 4A$. A horizontal magnetic field $B = 10T$ is switched on at time $t = 0$ as shown in figure. The initial angular acceleration of the ring is



A. $200\pi rad/s^2$

B. $400\pi rad/s^2$

C. $800\pi rad/s^2$

D. $1200\pi rad/s^2$

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314. A galvanometer having a coil resistance of 100ω gives a full scale deflection , when a current of $1mA$ is passed through it. The value of the resistance, which can convert this galvanometer into ammeter giving a full scale deflection for a current of $10A$, is :

A. $0 \cdot 01\Omega$

B. 2Ω

C. $0 \cdot 1\Omega$

D. 3Ω

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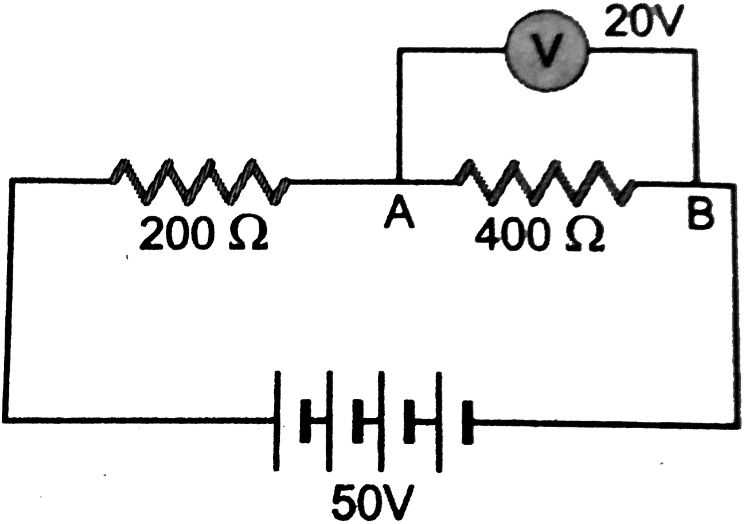
315. In the circuit given below, a voltmeter reads $20V$ when it is connected across 400Ω resistance. Calculate what the same voltmeter will read when connected across the 200Ω resistance.



A. $100V$

B. $50V$

C. $30V$

D. $10V$

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316. A galvanometer of resistance 25Ω is connected to a battery of 2 volt along with a resistance in series. When the value of this resistance is 3000Ω, a full scale deflection of 30 units is obtained in the galvanometer. In order to reduce this deflection to 20 units, the resistance in series will be

A. 4514Ω

B. 5413Ω

C. 2000Ω

D. 6000Ω

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317. In an ammeter $0 \cdot 2\%$ of main current passes through the galvanometer. If resistance of galvanometer is G, the resistance of ammeter will be

A. $\frac{G}{499}$

B. $\frac{499}{500}G$

C. $\frac{G}{500}$

D. $\frac{500}{499}G$

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318. A galvanometer has a sensitivity of 60 division/ampere. When a shunt is used its sentivity becomes 10 divisions/ampere. What is the value of shunt used if the resistance of the galvanometer is 20Ω?

A. 2Ω

B. 3Ω

C. 4Ω

D. 6Ω

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319. The current sensitivity of a moving coil galvanometer increases by 35%, when its resistance is increased by a factor 3. The voltage sensitivity of galvanometer changes by a factor

A. 0.35

B. 0.45

C. 0.55

D. none of the above

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320. A milli-voltmeter of 25 milli-volt range is to be converted into an ammeter of 25 ampere range. The value (in ohm) of necessary shunt will be:

A. $0 \cdot 001$

B. $0 \cdot 01$

C. 1

D. $0 \cdot 05$

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321. A magnet with moment M is given. If it is bent into a semicircular form, its new magnetic moment will be:

A. M / π

B. $M / 2$

C. M

D. $2M / \pi$

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322. A short bar magnet of magnetic moment $0 \cdot 4JT^{-1}$ is placed in a uniform magnetic field of $0 \cdot 16T$. The magnet is in stable equilibrium when the potencial energy is

A. $-0 \cdot 064J$

B. zero

C. $-0 \cdot 082J$

D. $0 \cdot 064J$

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323. A magnetic needle lying parallel to a magnetic field requires $W units$ of work to turn it through 60°. The torque needed to maintain the needle in this position will be

A. $2W$

B. W

C. $\frac{W}{\sqrt{2}}$

D. $\frac{W}{\sqrt{3}}$

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324. A magnetic needle suspended parallel to a magnetic field requires $\sqrt{3}J$ of work to turn it through 60°. The torque needed to maintain the needle in this postion will be:

A. $2\sqrt{3}J$

B. $3J$

C. $\sqrt{3}J$

D. $\frac{3}{2}J$

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325. An insulating rod of length l carries a charge q distrubuted uniformly on it. The rod is pivoted at its mid-point and is rotated at a frequency f about a fixed axis perpendicular to the the rod and passing through the pivot . The magnetic moment of the rod system is

A. $\frac{\pi Q v L^2}{2}$

B. $\frac{\pi Q v L^2}{3}$

C. $\frac{\pi Q v L^2}{6}$

D. $\frac{\pi Q v L^2}{12}$

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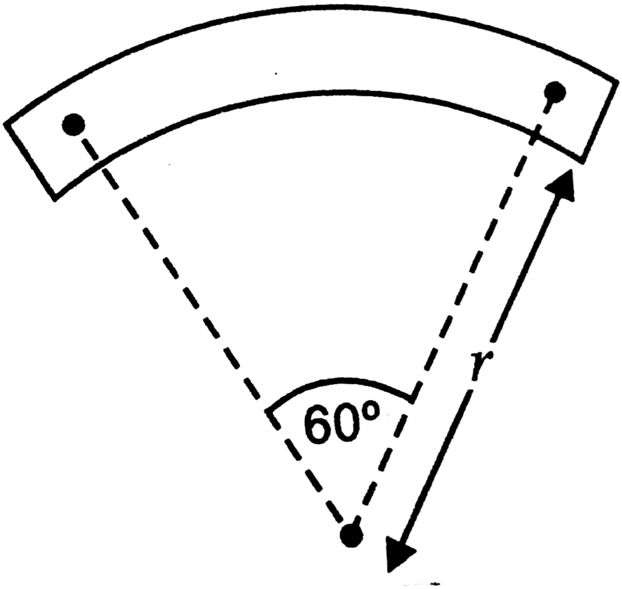
326. A bar magnet of lenth l and magnetic dipole moment 'M' is bent in the form of an arc as shown in figure. The new magnetic dipole moment will be



A. $\frac{M}{2}$

B. M

C. $\frac{3}{\pi}M$

D. $\frac{2}{\pi}M$

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327. A 250-turns recantagular coil of length 2.1 cm and width 1.25 cm carries a current of $85\mu A$ and subjected to magnetic field of strength $0.85T$. Work done for rotating the coil by 180° against the torque is

A. $9 \cdot 1\mu J$

B. $4 \cdot 55\mu J$

C. $2 \cdot 3\mu J$

D. $1 \cdot 15\mu J$

Watch Video Solution

328. If θ_1 and θ_2 be the apparent angles of dip observed in two vertical planes at right angles to each other, then the true angle of dip θ is given by

A. $\cot^2\theta = \cot^2\theta_1 + \cot^2\theta_2$

B. $\tan^2\theta = \tan^2\theta_1 + \tan^2\theta_2$

C. $\cot^2\theta = \cot^2\theta_1 - \cot^2\theta_2$

D. $\tan^2\theta = \tan^2\theta_1 - \tan^2\theta_2$

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329. A magnetic needle of magnetic moment $6 \cdot 7 \times 10^{-2} Am^2$ and moment of inertia $7 \cdot 5 \times 10^{-6} kgm^2$ is performing simple harmonic oscillations in a magnetic field of $0 \cdot 01T$. Time taken for 10 complete oscillation is

A. $6 \cdot 98s$

B. $8 \cdot 76s$

C. $6 \cdot 65s$

D. $8 \cdot 89s$

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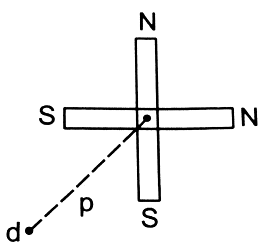
330. Two short magnets of equal dipole moments M are fastened perpendicularly at their centres (figure). The magnitude of the magnetic field at a distance d from the centre on the bisector of the right angle is



A. $\dfrac{\mu_0}{4\pi}\dfrac{2M\sqrt{2}}{d^3}$

B. $\dfrac{\mu_0}{4\pi}\dfrac{M}{d^3}$

C. $\dfrac{\mu_0}{4\pi}\dfrac{M\sqrt{2}}{d^3}$

D. $\frac{\mu_0}{4\pi}\frac{2M}{d^3}$

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331. Two identical magnetic dipoles of magnetic moments $1 \cdot 0Am^2$ each are placed at a separation of $2m$ with their axes perpendicular to each other. What is the resultant magnetic field at a point midway between the dipoles?

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

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

C. $10^{-7}T$

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

Answer: B

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332. Two wires of same length are shaped into a square and a circle. If they carry same current, ratio of the magnetic moment is

A. $2 : \pi$

B. $\pi : 2$

C. $4 : \pi$

D. $\pi : 4$

Answer: D

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333. Two identical magnetic dipoles of magnetic moments $2Am^2$ are placed at a separation of $2m$ with their axes perpendicular to each other in air. The resultant magnetic field at a mid point between the dipole is

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

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

C. $4\sqrt{5} \times 10^{-7} T$

D. $2\sqrt{5} \times 10^{-7} T$

Answer: D

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334. A vibration magnetometer placed in magnetic meridian has a small bar magnet. The magnet executes oscillations with a time period of 2 sec in earth's horizontal magnetic field of 24 microtesla. When a horizontal field of 18 microtesla is produced opposite to the earth's field by placing a current carrying wire, the new time period of magnet will be

A. $1s$

B. $2s$

C. $3s$

D. $4s$

Answer: D

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335. A magnet is cut in three equal parts by cutting it perpendicular to its length. The time period of original magnet is T_0 in a uniform magnetic field B. Then, the time period of each part in the same magnetic field is

A. $\frac{T_0}{2}$

B. $\frac{T_0}{3}$

C. $\frac{T_0}{4}$

D. none of these

Answer: B

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336. A magnetic substance has suceptibility $-0 \cdot 05$ at $300K$. The magnetic susceptibility of the substance at $600K$ will be

A. $-0 \cdot 025$

B. $-0 \cdot 01$

C. $-0 \cdot 05$

D. $-0 \cdot 0125$

Answer: C

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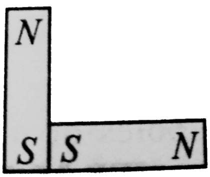
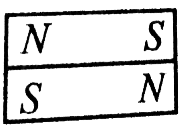
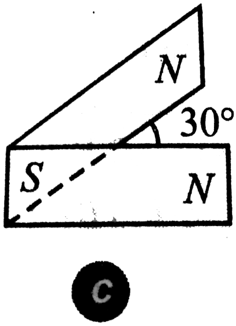
337. Following figures show the arrangement of bar magnets in different configurations. Each magnet has magnetic dipole moment (m). Which configuration has highest value of magnetic dipole moment?

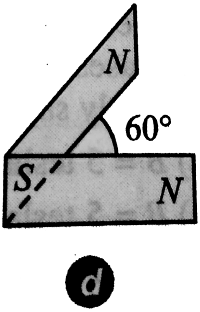
A. 

a

B. 

b

C. 

D. 

Answer: C

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338. At a place of latitude 5°, angle of dip is nearly

A. 10°

B. 5°

C. 20°

D. $7 \cdot 5^{\circ}$

Answer: A

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339. The magnetic susceptibility is negative for

A. diamagnetic material only

B. paramagnetic material only

C. ferromagnetic material only

D. paramagnetic and ferromagnetic materials

Answer: A

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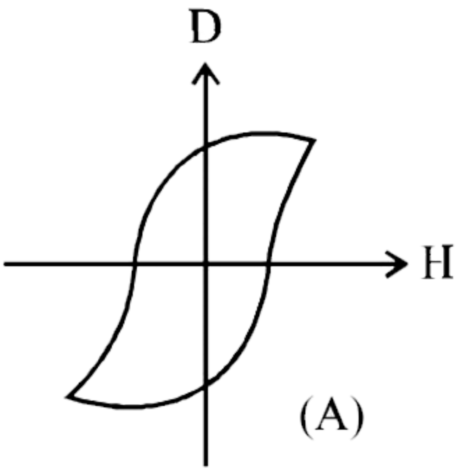
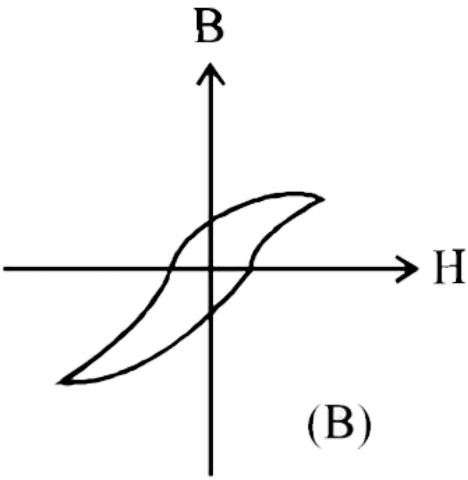
340. Hysteresis loops for two magnetic materials A and B are given below :



(A)



(B)

These materials are used to make magnets for electric generators , transformer core and electromagnet core. Then it is proper to use :

A. A for electric generators and transformers

B. A for electromagnets and B for electric generatos

C. A for transformers and B for electric generators

D. B for electromagnets and transformers.

Answer: D

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341. For which of the following magnetic materials, $B = \mu H$ is valid, where B is the magnetic induction and H is the magnetising field and μ is nearly a constant for a wide range of H?

A. Diamagnetic and ferromagnetic materials only

B. Diamagnetic and paramagnetic materials only

C. Paramagnetic and ferromagnetic materials only

D. Diamagnetic, paramagnetic and ferromagnetic materials

Answer: D

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342. Nickel shows ferromagnetic property at room temperature. If the temperature is increased beyond curie temperature, then it will show

A. anti-ferromagnetic

B. no magnetic property

C. diamagnetism

D. paramagnetism

Answer: D

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343. Needles $N_1, N_2,$ and N_3 are made of a ferromagnetic, a paramagnetic and a diamagnetic substance respectively . A magnet when brought close to them will

A. attract N_1 strongly, but repel N_2 and N_3 weekly

B. attract all three of them

C. attract N_1 and N_2 strongly, but repel N_3

D. attract N_1 strongly, N_2 weakly and repel N_3 weakly

Answer: D

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344. If the magnetic dipole of moment of an atom of diamagnetic material, paramagnetic material and ferromagnetic material are donated by μ_d, μ_p and μ_f respectively, then:

A. $\mu_p = 0$ and $\mu_f \neq 0$

B. $\mu_d = \neq 0$ and $\mu_p = 0$

C. $\mu_d \neq 0$ and $\mu_f \neq 0$

D. $\mu_d = 0$ and $\mu_p \neq 0$

Answer: D

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345. Ferro magnetic materials used in transformer must have

A. low permeability and high hysteresis loss

B. high permeability and low hysteresis loss

C. high permeability and high hysteresis loss

D. low permeability and low hysteresis loss

Answer: B

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346. If the magnetising field on a ferromagnetic material is increased, its permeability is

A. decreased

B. increased

C. is unaffected

D. may be increased or decreased

Answer: A

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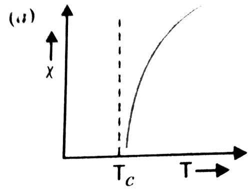
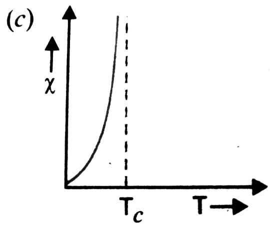
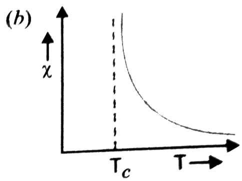
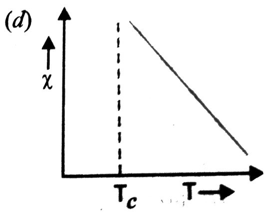
347. The variation of magnetic susceptibility χ with the temperature T of a ferromagnetic material can be plotted as

A. 

B. 

C. 

D. 

Answer: B

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

A. $3A$

B. $6A$

C. $30mA$

D. $60mA$

Answer: A

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349. A superconductor has $T_c(0) = 100K$. When a magnetic field of $7 \cdot 5 tesla$ is applied, its T_c decreases to $75K$. For this material, one can definitely say that when

A. $B = 5tesla, T_c(B) = 80K$

B. $B = 5tesla, 75K < T_c < 100K$

C. $B = 10tesla, 75K < T_c(B) < 100K$

D. $B = 10tesla, T_c(B) = 70K$

Answer: B

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350. A current I flows along the length of an infinitely long, straight , thin - walled pipe. Then

A. the magnetic field at all points inside the pipe is same but not zero.

B. the magnetic field at any point inside the pipe is zero

C. the magnetic field is zero only on the axis of the pipe

D. the magnetic field is different at different points inside the pipe

Answer: B

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351. A proton moving with a constant velocity passes through a region of space without any changing its velocity. If E and B represent the electric and magnetic fields, respectively. Then, this region of space may have

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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352. A charged particle of mass m and charge e is released from rest in an electric field E. If kinetic energy of particle after time t is E_k and linear momentum is p, then

A. $p = Eet$

B. $p = 2eEt$

C. $E_K = \frac{e^2E^2t^2}{2m}$

D. $E_K = \frac{e^2E^2t^2}{m}$

Answer: A::C

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353. The K.E. (K) of a charged particle is zero at time t, 2K at time $4t$ and $4k$ at time $5t$ and then it remains constant upto time $8t$. Choose the correct statement/statements out of the following:

A. The electric field is the only field present between t and $4t$

B. Between $5t$ and $8t$ only magnetic field is present

C. Both, electric and magnetic fields may be present

D. Both, electric and magnetic fields may be present between t and $4t$, but electric field is definitely present.

Answer: C::D

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

A. H^{+} will be deflected most

B. O^{2+} will be deflected most

C. He^{+} and O^{2+} will be deflected equally

D. all will be deflected equally

Answer: A::C

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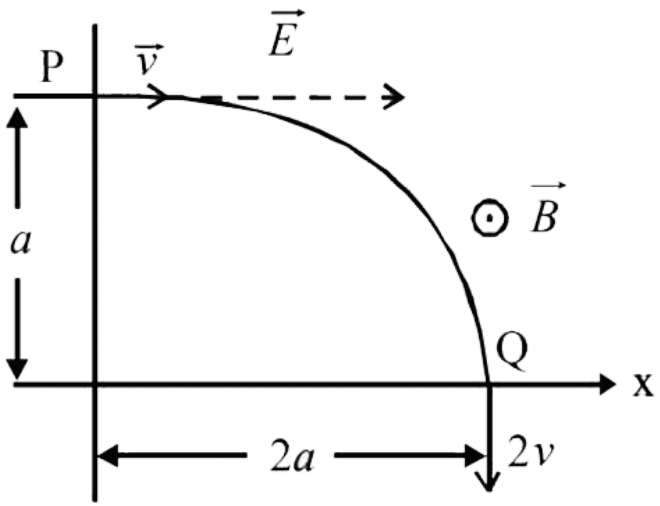
355. A particle of charge $+q$ and mass m moving under the influence of a uniform electric field $E\hat{i}$ and uniform magnetic field $B\hat{k}$ follows a trajectory from $P \rightarrow Q$ as shown in fig. The velocities at P and Q are $v\hat{i}$ and $-2v\hat{j}$. which of the following statement(s)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



A. $E = \frac{3}{4}\left(\frac{mv^2}{qa}\right)$

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

C. Rate of work done by the electric field at $P = 0$

D. Rate of work done by both fields at Q is zero

Answer: A::B::D

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356. Velocity and acceleration vector of a charged particle moving in a magnetic field at some instant are $\vec{v} = 3\hat{i} + 4\hat{j}$ and $\vec{a} = 2\hat{i} + x\hat{j}$. Select the correct options.

A. $x = -1 \cdot 5$

B. $x = 3$

C. magnetic field is along z-direction

D. K.E. of particle is constant

Answer: A::C::D

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357. An electron and a proton are moving on straight parallel paths with same velocity. They enter a semi infinite region of uniform magnetic field perpendicular to the velocity.

Which of the following statement(s) is /are true?

A. They will never come out of the magnetic field region

B. They will come out travelling along parallel paths

C. They will come out at the same time

D. They will come out at different times.

Answer: B::D

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

A. If $\theta = 0\,°$, the charge moves in a circular path in the x-z plane

B. If $\theta = 0\,°$, the charge undergoes helical motion with constant pitch along the y-axis

C. If $\theta = 10\,°$, the charge undergoes helical motion with its pitch increasing with time, along the y-axis.

D. If $\theta = 90\,°$, the charge undergoes linear but accelerated motion along the y-axis

Answer: C::D

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359. A long straight wire carries the current along +ve x-direction. Consider four points in space $A(0, 1, 0), B(0, 1, 1), C(1, 0, 1)$, and $D(1, 1, 1)$. Which of the pairs will have the same magnitude of magnetic field?

A. A and B

B. A and C

C. B and C

D. B and D

Answer: B::D

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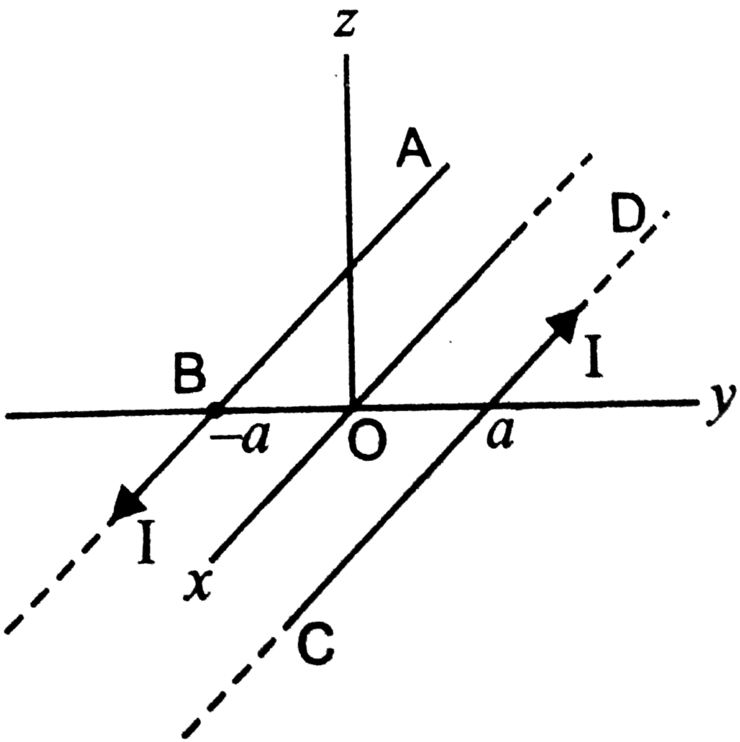
360. Two long parallel wires, AB and CD, carry equal currents in opposite directions. They lie in the x-y plane, parallel to the x-axis, and pass through the points (0,-a,0) and (0,a,0) respectively, Figure. The resultant magnetic field is:



A. zero on the x-axis

B. maximum on the x-axis

C. directed along the z-axis at the origin, but not at other points on the z-axis

D. directed along the z-axis at all points on the z-axis.

Answer: B::D

Watch Video Solution

361. A beam of electrons starts to accelerate from rest due to a uniform electric field in vacuum, the moving electrons:

A. initially experience a force of mtual repulsion

B. experience a force of mutual attraction after travelling a certain distance

C. will continue to diverge due to electrostatic repulsion

D. will follow parallel lines because there is no force of attraction between them.

Answer: A::B

Watch Video Solution

362. Current flows through a straight cylindrical conductor of radius r. The current is distributed uniformly over its cross-section. The magnetic field at a distanace x from the axis of the conductor has magnitude B:

A. $B = 0$ at the axis

B. $B \propto x$ for $0 \leq x \leq r$

C. $B \propto 1/x$ for $x > r$

D. B is maximum for $x = r$

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

Watch Video Solution

363. A bar magnet is osciallating in the earth's magnetic field with a period T. What happens to its period of motion of its mass is quad-rupled without changing its dimensions?

A. Motion remains SHM with period $= T/2$

B. Motion remains SHM with period $= 2T$

C. Motion remains SHM with period $= 4T$

D. Motion is not SHM, but period $= T$

Answer: B

Watch Video Solution

364. A microameter has a resistance of 100ω and a full scale range of $50\mu A$. It can be used as a voltmeter or as a higher range ammeter provides a resistance is added to it . Pick the correct range and resistance combination(s)

A. $50V$ range with $10k\Omega$ resistance in series

B. $10V$ range with $200k\Omega$ resistance in series

C. $5mA$ range with 1Ω resistance in parallel

D. $10mA$ range with 1Ω resistance in parallel

Answer: B::C

Watch Video Solution

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

A. the two circles touch each other

B. the two circles do not touch each other

C. the circle described by the singly-ionized charge will have a radius double that of the other circle

D. both the ions will go along circles of equal radii.

Answer: A::C

Watch Video Solution

366. Let $\vec{E}$ and $\vec{B}$ denote electric and magnetic fields in a frame S and$\vec{E}'$ and $\vec{B}'$ in another frame S' moving with respect to S at a velocity $\vec{v}$. Two of the following equations are wrong. Identify them.

A. $E'_y = E_y - \frac{vB_z}{c^2}$

B. $E'_y = E_y + vB_z$

C. $B'_y = B_y + vE_z$

D. $B'_y = B_y + \frac{vE_z}{c^2}$.

Answer: A::C

Watch Video Solution

367. Consider a magnetic dipole kept in the north to south direction. Let P_1, P_2, Q_1, Q_3 be four points at the same distance from the dipole towareds north, south, east and west of the dipole respectively. The directions of the magnetic field due to the dipole are the same at

A. P_1 and P_2

B. Q_1 and Q_2

C. (b) P_1 and Q_1

D. P_2 and Q_2.

Answer: A::B

Watch Video Solution

368. A horizontal circular loop carries a current that looks anticlockwise then viewed from above. It is replaced by an equivalent magnetic dipole NS, which of the following is true?

A. The line NS should be along a diameter of the loop.

B. The line NS should be perpendicular to the plane of the loop.

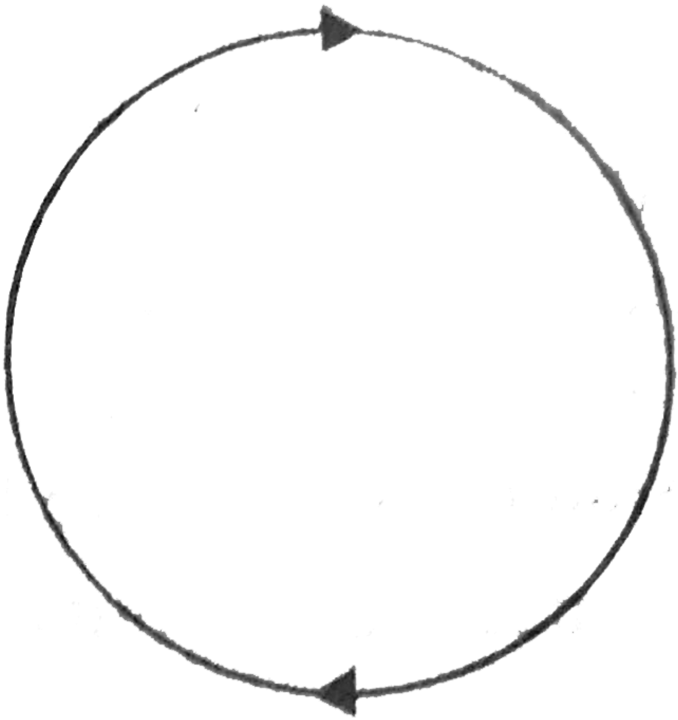
C. South pole should be below the loop.

D. North pole should be below the loop.

Answer: B::C

Watch Video Solution

369. In the given diagram, a line of force of a particular field is shown in figure. Out of the following options, it can never represent



A. an electric field

B. a magnetic field

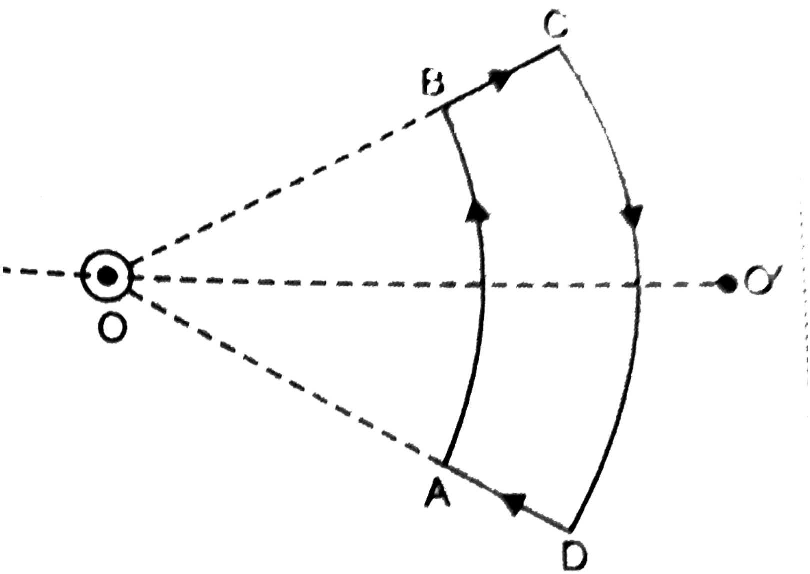
C. a gravitational field of a mass at rest

D. an induced electric field

Answer: A::C

Watch Video Solution

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



A. Net force on the loop is zero.

B. Net torque on the loop is zero.

C. As seen from O, the loop rotates clockwise.

D. As seen from O, the loop rotates anticlockwise.

Answer: A::C

Watch Video Solution

371. A charged particle of mass m and charge e is released from rest in an electric field of constant magnitude E. The kinetic energy of the particle after time t is E_k and the linear momentum is p. We have

A. $p = Eet$

B. $p = 2eEt$

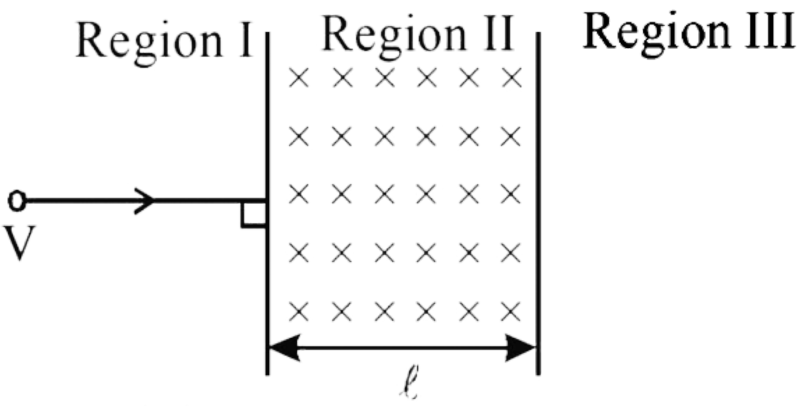
C. $E_k = \dfrac{e^2E^2t^2}{2m}$

D. $E_k = \dfrac{e^2E^2t^2}{m}$

Answer: A::C

Watch Video Solution

372. A particle of mass $m$and charge q, moving with velocity v enters Region II normal to the boundary as shown in the figure. Region II has a uniform magnetic field B perpendicular to the plane of the paper . The length of the region II is l. Choose the correct choice(s).



A. The particle enters region III only if its velocity $v > qlB/m$

B. The particle enters region III only if its velocity $v < qlB/m$

C. Path length of the particle in region II is maximum when velocity $v = \dfrac{qlB}{m}$

D. Time spent in region II is same for any velocity v as long as the particle returns to region I

Answer: A::C::D

Watch Video Solution

373. A particle of mass M and positive charge Q, moving with a constant velocity $\vec{u_1} = 4\hat{i}ms^{-1}$, enters a region of uniform static magnetic field , normal to the $x-y$ plane. The region of the magnetic field extends from $x = 0$ to $x = L$ for all values of y. After passing through this region, the particle emerges on the other side after $10 milliseconds$ with a velocity $\vec{u_2} = 2\left(\sqrt{3}\hat{i} + \hat{j}\right)ms^{-1}$. The correct statement(s) is (are)

A. the direction of magnetic field is -z direction

B. the direction of magnetic field is $+z$ direction

C. the magnitude of magnetic field is $\frac{50\pi M}{3Q}$ units

D. the magnitude of magnetic field is $\frac{100\pi M}{3Q}$ units

Answer: A::C

Watch Video Solution

374. A steady current I flows along an infinitely long hollow cylindrical conductor of radius R. This cylinder is placed coaxially inside an infinite solenoid of radius $2R$. The solenoid has a n turns per unit length and carries a steady current I. Consider a point p at a distance r from the common axis . The correct statement(s) is (are)

A. In the region $\theta < r < R$, the magnetic field is non-zero.

B. In the region $R < r < 2R$, the magnetic field is along the common axis

C. In the region $R < r < 2R$, the magnetic field is tangent to the circle of radis r, centred on the axis

D. In the region $r > 2R$, the magnetic field is non-zero.

Answer: A::D

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375. In cyclotron, an ion is made to travel successively along semicircles of increasing radius under the action of a magnetic field. The angular velocity of the ion is independent of

A. speed of ion

B. radius of the circle

C. mass of the ion

D. charge of the ion

Answer: B

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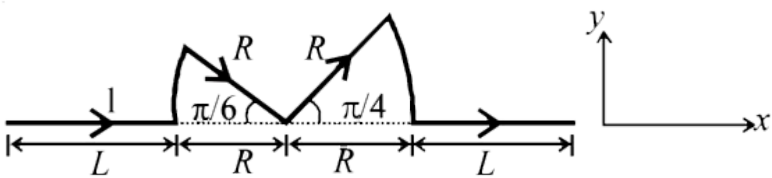
376. A conductor (shown in the figure) carrying constant current I is kept in the x - y plane in a uniform magnetic field $\vec{B}$. If $\vec{F}$ is the magnitude of the total magnetic force acting on the conductor, then the correct statement(s) is (are)



A. If $\vec{B}$ is along $\hat{z}$, $F \propto (L + R)$

B. If $\vec{B}$ is along $\hat{x}$, $F = 0$

C. If $\vec{B}$ is along $\hat{y}$, $F \propto (L + R)$

D. If $\vec{B}$ is along $\hat{z}$, $F = 0$

Answer: A::B::C

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377. In a moving coil galvanometer, there is a coil of copper having number of insulated turns N, each of area A. The coil is suspended in a radial magnetic field B. The moment of inertia of the coil about its rotational axis is I. The scale divisions in the galvanometer are n and resistance of the coil is R.

If a current i_0 in the coil produces a deflection of $\pi/3$ radian to the pointer of galvanometer, the value of torsional constant of the spring is

A. $\frac{NBAi_0}{3\pi}$

B. $\frac{3NBAi_0}{2\pi}$

C. $\frac{NBAi_0\pi}{3}$

D. $\frac{3NBAi_0}{\pi}$

Answer: D

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378. In a moving coil galvanometer, there is a coil of copper having number of insulated turns N, each of area A. The coil is suspended in a radial magnetic field B. The moment of inertia of the coil about its rotational axis is I. The scale divisions in the galvanometer are n and resistance of the coil is R.

If the charge Q is passed almost instantaneously through the coil, the angular speed of the coil immediately after this is

A. $\frac{NBAQ}{I}$

B. $\frac{2NBAQ}{I}$

C. $\frac{3NBAQ}{I}$

D. $\frac{NBAQ^2}{I}$

Answer: A

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379. The earth's magnetic field is approximately like that of a giant magnetic dipole, whose axis is inclined roughly 20° west of the axis of rotation of earth which is the geographic N-S direction. The strength of earth's magnetic field is of the order of 10^{-4} *tesla*.

Three magnetic elements of earth are: Magnetic declination (θ), magnetic inclination or magnetic dip (δ) and horizontal component (H) of earth's magnetic field. Magnetic declination is the small angle between magnetic axis and geographic axis at a place. Magnetic dip at a place is the angle, which the direction of total strength of earth's magnetic field (R) makes with a horizontal line in magnetic meridian. If H is horizontal component and V is vertical component of earth's magnetic field, then $H = R\cos\delta$, $V = R\sin\delta$ and $R = \sqrt{H^2 + V^2}$. At a place on the surface of earth. H is of the order of $3 \cdot 3 \times 10^{-5} tesla$.

The intensity of earth's magnetic field at the surface of earth is of the order of

A. $10^{-4}T$

B. $10^{-4}G$

C. $10^{-3}T$

D. $10^{-3}G$

Answer: A

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380. The earth's magnetic field is approximately like that of a giant magnetic dipole, whose axis is inclined roughly 20° west of the axis of rotation of earth which is the geographic N-S direction. The strength of earth's magnetic field is of the order of $10^{-4} tesla$. Three magnetic elements of earth are: Magnetic declination (θ), magnetic inclination or magnetic dip (δ) and horizontal component (H) of earth's magnetic field. Magnetic declination is the small angle between magnetic axis and geographic axis at a place. Magnetic dip at a place is the angle, which the direction of total strength of earth's magnetic field (R) makes with a horizontal line in magnetic meridian. If H is horizontal component and V is vertical component of earth's magnetic field, then $H = R\cos\delta$, $V = R\sin\delta$ and $R = \sqrt{H^2 + V^2}$. At a place on the surface of earth. H is of the order of $3 \cdot 3 \times 10^{-5} tesla$.

The vertical component of earth's magnetic field is zero at a place where angle of dip is

A. 45°

B. 60°

C. 90°

D. 0°

Answer: D

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381. The earth's magnetic field is approximately like that of a giant magnetic dipole, whose axis is inclined roughly 20° west of the axis of rotation of earth which is the geographic N-S direction. The strength of earth's magnetic field is of the order of $10^{-4} tesla$.

Three magnetic elements of earth are: Magnetic declination (θ), magnetic inclination or magnetic dip (δ) and horizontal component (H) of earth's magnetic field. Magnetic declination is the small angle between magnetic axis and geographic axis at a place. Magnetic dip at a place is the angle, which the direction of total strength of earth's magnetic field (R) makes with a horizontal line in magnetic meridian. If H is horizontal component and V is vertical component of earth's magnetic field, then $H = R\cos\delta$, $V = R\sin\delta$ and $R = \sqrt{H^2 + V^2}$. At a place on the surface of earth. H is of the order of $3 \cdot 3 \times 10^{-5} tesla$.

At magnetic poles, a compass needle points out

A. along N-S

B. in any direction

C. along E-W

D. at 45° to N-S direction

Answer: B

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382. The earth's magnetic field is approximately like that of a giant magnetic dipole, whose axis is inclined roughly 20° west of the axis of rotation of earth which is the geographic N-S direction. The strength of earth's magnetic field is of the order of $10^{-4} tesla$. Three magnetic elements of earth are: Magnetic declination (θ), magnetic inclination or magnetic dip (δ) and horizontal component (H) of earth's magnetic field. Magnetic declination is the small angle between magnetic axis and geographic axis at a place. Magnetic dip at a place is the angle, which the direction of total strength of earth's magnetic field (R) makes with a horizontal line in magnetic meridian. If H is horizontal component and V is vertical component of earth's magnetic field, then $H = R\cos\delta$, $V = R\sin\delta$ and $R = \sqrt{H^2 + V^2}$. At a place on the surface of earth. H is of the order of $3 \cdot 3 \times 10^{-5} tesla$.

Magnetic declination is

A. 20° west

B. 20° south

C. 20° east

D. 20° north

Answer: A

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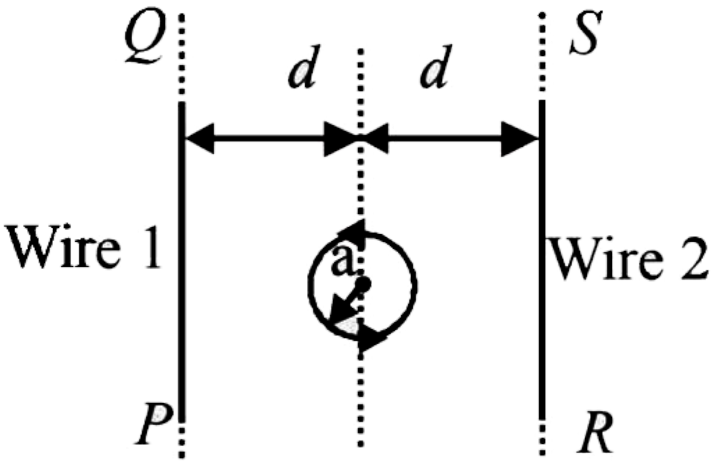
383. The figure shows a circular loop of radius a with two long parallel wires $(vmbered1 \text{ and } 2)$ all in the plane of the paper . The distance of each wire from the centre of the loop is d. The loop and the wire are carrying the same current I. The current in the loop is in the counterclockwise direction if seen from above.

(q) The magnetic fields(B) at P due to the currents in the wires are in opposite directions.

(r) There is no magnetic field at P.

(s) The wires repel each other.



(4) When $d \approx a$ but wires are not touching the loop , it is found that the net magnetic field on the axis of the loop . In that case

A. current in wire 1 and wire 2 is in the direction PQ and RS, respectively and $h = a$

B. current in wire 1 and wire 2 is in the direction PQ and SR, respectively and $h = a$

C. current in wire 1 and wire 2 is in the direction PQ and SR, respectively and $h = 1 \cdot 2a$

D. current in wire 1 and wire 2 is in the direction PQ and RS, respectively and $h = 1 \cdot 2a$

Answer: C

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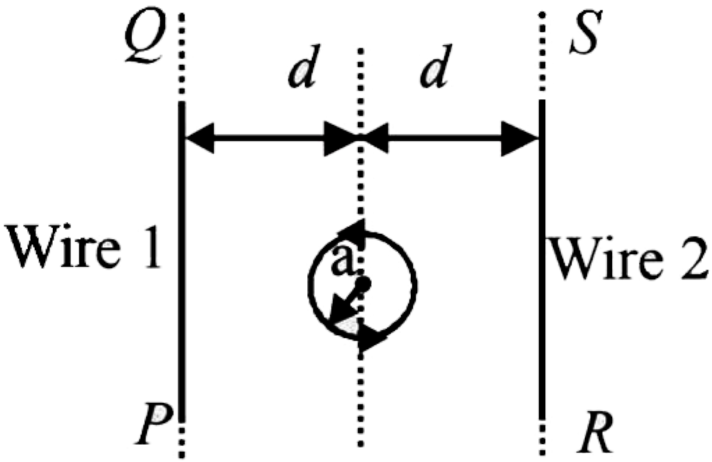
384. The figure shows a circular loop of radius a with two long parallel wires $(vmbered 1 \text{ and } 2)$ all in the plane of the paper . The distance of each wire from the centre of the loop is d. The loop and the wire are carrying the same current I. The current in the loop is in the counterclockwise direction if seen from above.

(q) The magnetic fields(B) at P due to the currents in the wires are in opposite directions.

(r) There is no magnetic field at P.

(s) The wires repel each other.



(5) Consider $d >> a$, and the loop is rotated about its diameter parallel to the wires by $30°$ from the position shown in the figure. If the currents in the wire are in the opposite directions, the torque on the loop at its new position will be (assume that the net field due to the wires is constant over the loop).

A. $\frac{\mu_0 I^2 a^2}{d}$

B. $\frac{\mu_0 I^2 a^2}{2d}$

C. $\frac{\sqrt{3}\mu_0 I^2 a^2}{d}$

D. $\frac{\sqrt{3}\mu_0 I^2 a^2}{2d}$

Answer: B

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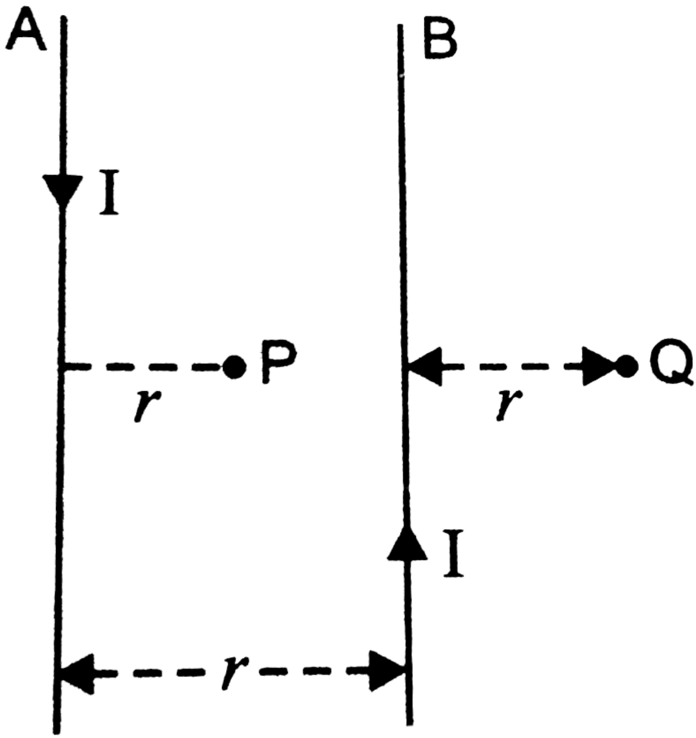
385. There are two infinite long parallel straight current carrying wires, A and B separated by a distance r. Figure. The current in each wire is I. The ratio of magnitude of magnetic field at point P and Q when points P and Q lie in the plane of wires is:



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386. A length of wire carries a steady current I. It is bent first to form a circular plane coil of one turn. The same length is now bent more sharply to give double loop of smaller radius. If the same current I is passed, the ratio of the magnitude of magnetic field at the centre with its first value is:

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387. A current of $1 \cdot 0A$ flowing in the sides of an equilateral triangle of side $4 \cdot 5 \times 10^{-2} m$. Find the magnetic fied at the centroid of the triangle.

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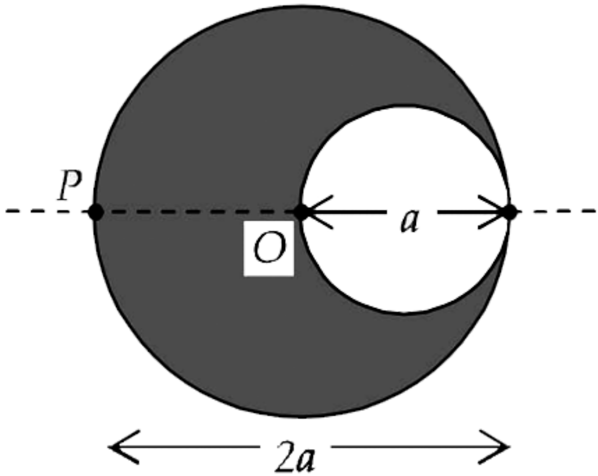
388. A cylindrical cavity of diameter a exists inside a cylinder of diameter $2a$ as shown in the figure. Both the cylinder and the cavity are infinitity long. A uniform current density j flows along the length . If the magnitude of the magnetic field at the point P

is given by $\frac{N}{12}\mu_0 aJ$, then the value of N is



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389. A galvanometer gives full scale deflection with 0.006 A current. By connecting in to a 4990Ω resistance, it can be converted into a voltmeter of range 0-30V. If connected to a $\frac{2n}{249}\Omega$ resistance, it becomes an ammeter of range $0 - 1.5A$. The value of n is

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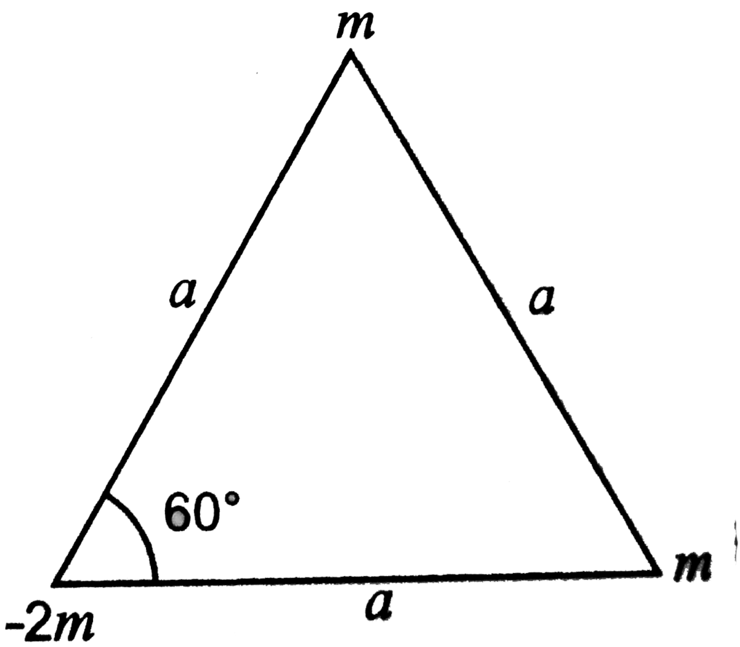
390. The net magnetic moment of the system of magnetic poles shown in figure. is ma where n is nearly:



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391. The coercivity of a bar magnet is $120A/m$. It is to be demagnetised by placing it inside a solenoid of length $120cm$ and number of turns 72. The current (in A) flowing through the solenoid is:

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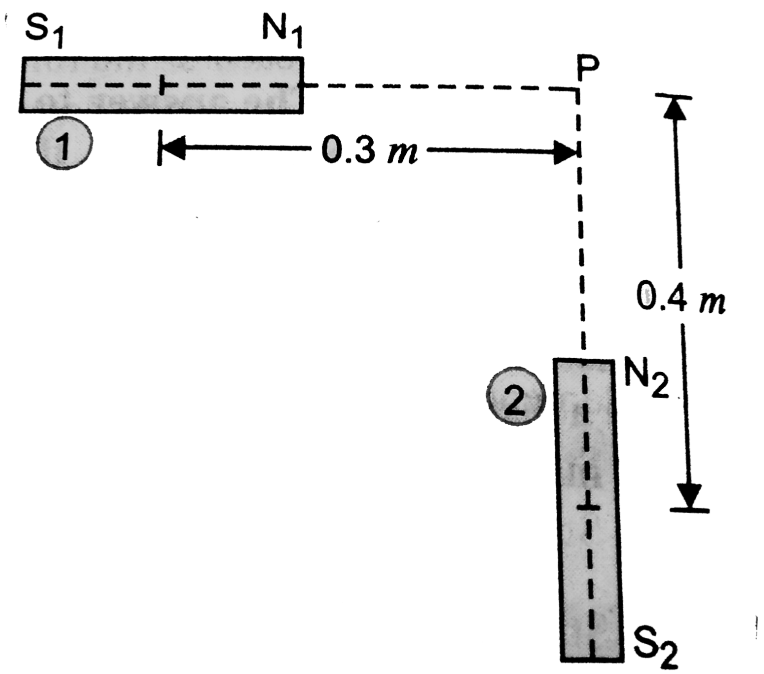
392. Two short magnets (1) and (2) of magnetic moments $2Am^2$ and $5Am^2$ respectively are placed along two lines drawn at 90° to each other as shown in figure. At the point of intersection of their axes, the magnitude of magnetic field is $n \times 10^{-5}T$. What is n?



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393. Statement 1: If a proton and an α-particle enter a uniform magnetic field perpendicularly with the same speed, the time period of revolution of α-particle is double than that of proton.

Statement 2: In a magnetic field, the period of revolution of a charged particle is directly proportional to the mass of the particle and inversely proprotional to the charge of particle.

A. both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both Assertion and Reason are false.

Answer: A

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

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

A. both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both Assertion and Reason are false.

Answer: D

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395. Assertion: Poles of a magnet can never be separated.

Reason: Since each atom of a magnetic material is a magnet in itself.

A. both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both Assertion and Reason are false.

Answer: A

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396. Assertion: When a magnetic dipole is placed in a non uniform magnetic field, only a torque acts on the dipole.

Reason: Force would also acts on dipole if magnetic field were uniform.

A. both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both Assertion and Reason are false.

Answer: D

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397. Assertion: Magnetic moment is a vector quantity, whose direction inside the magnet is, from South to North.

Reason: Magnetic lines of force emanate from N-pole and enter into the S-pole.

A. both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both Assertion and Reason are false.

Answer: A

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398. Assertion: An atom of a magnetic material behaves as a dipole because of positive charge on the nucleus.

Reason: Charge is responsible for dipole moment.

A. both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both Assertion and Reason are false.

Answer: D

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399. The magntic moment (μ) of a revolving electron around the mucleaus varies with principle quantum number n as

A. both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both Assertion and Reason are false.

Answer: D

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400. Assertion: Above Curie temperature, a frerromagnetic material becomes paramagnetic.

Reason: When a magnetic material is heated to very high temperature, it loses its magnetic properties.

A. both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both Assertion and Reason are false.

Answer: A

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401. Statement-1: If an electron and proton enter a perpendicular magnetic field with equal momentum, then path of electron is more curved than that of proton.

Statement-2: Electron is lighter particle.

A. Statement-1 is true, Statement-2 is true, Statement-2 is a correct explaination of Statement-1.

B. Statement-1 is true, Statement-2 is true, Statement-2 is not a correct explanation of Statement-1.

C. Statement-1 is true, Statement-2 is false.

D. Statement-1 is false, Statement-2 is true.

Answer: D

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402. This questions has Statement I and Statement II. Of the four choices given after the Statements, choose the one that best describes into two Statements.

Statement-I : Higher the range, greater is the resistance of ammeter.

Statement- II : To increase the range of ammeter, additional shunt needs to be used across it.

A. Statement-1 is true, Statement-2 is true, Statement-2 is a correct explaination of Statement-1.

B. Statement-1 is true, Statement-2 is true, Statement-2 is not a correct explanation of Statement-1.

C. Statement-1 is true, Statement-2 is false.

D. Statement-1 is false, Statement-2 is true.

Answer: D

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403. Statement-1: A proton and an α- particle are projected with the same kinetic energy at right angles to a uniform magnetic field, then the α-particle will move along a circular path of smaller radius than the proton.

Statement-2: $Bqv = \frac{mv^2}{r}$

A. Statement-1 is true, Statement-2 is true, Statement-2 is a correct explaination of Statement-1.

B. Statement-1 is true, Statement-2 is true, Statement-2 is not a correct explanation of Statement-1.

C. Statement-1 is true, Statement-2 is false.

D. Statement-1 is false, Statement-2 is true.

Answer: D

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

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

A. Statement-1 is true, Statement-2 is true, Statement-2 is a correct explaination of Statement-1.

B. Statement-1 is true, Statement-2 is true, Statement-2 is not a correct explanation of Statement-1.

C. Statement-1 is true, Statement-2 is false.

D. Statement-1 is false, Statement-2 is true.

Answer: A

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405. Statement-1: Magnetic field strength at a point on axial line of a bar magnet is along South to North pole of magnet.

Statement-2: The magnetic field strength can never be along North to South pole of magnet.

A. Statement-1 is true, Statement-2 is true, Statement-2 is a correct explaination of Statement-1.

B. Statement-1 is true, Statement-2 is true, Statement-2 is not a correct explanation of 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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406. Statement -1 : The sensitvity of a moving coil galvanometer is increased by placing a suitable magnetic material as a core inside the coil.

Statement - 2: Soft iron has a high magnetic permeability and cannot be easily magnetized or demagnetized.

A. Statement-1 is true, Statement-2 is true, Statement-2 is a correct explaination of Statement-1.

B. Statement-1 is true, Statement-2 is true, Statement-2 is not a correct explanation of 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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407. A galvanometer with resistance 1000Ω gives full scale deflection at $0 \cdot 1mA$. What value of resistance should be added to 1000Ω to increase its current range $10A$.

A. $0 \cdot 01\Omega$ in series

B. $0 \cdot 01\Omega$ in parallel

C. $0 \cdot 10\Omega$ in series

D. $0 \cdot 10\Omega$ in parallel

Answer: B

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408. A galvanometer of resistance 3663Ω gives full scale deflection for a certain current I_g. The value of the resistance of the shunt which when joined to the galvanometer coil will result in $1/34$ of the total current passing through the galvanometer is

A. 100Ω

B. 200Ω

C. 300Ω

D. none of the above

Answer: D

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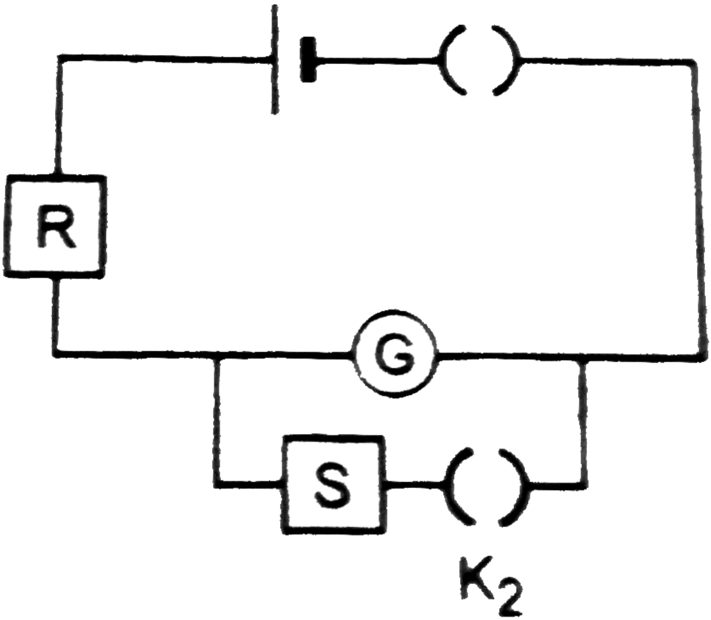
409. In the circuit, shown in figure. $R = 5000\Omega$. If key K_1 is closed, galvanometer shows a deflection of 30 scale division. On closing key K_2 and making $S = 20\Omega$, the deflection of galvanometer reduces to 15 division. The resistance of galvanometer is



A. 50Ω

B. 30Ω

C. 20Ω

D. 15Ω

Answer: C

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410. A galvanometer having 20 division scale and 50Ω resistance is connected in series to a cell of e.m.f. $1 \cdot 5V$ through a resistance of 100Ω, shows full scale deflection. The figure of merit of the galvanometer in microampere/division is

A. 330

B. 660

C. 500

D. 600

Answer: C

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411. A resistance of 980Ω is connected in series with a voltmeter, after which the scale division becomes 50 times larger. The resistance of voltmeter is

A. 10Ω

B. 20Ω

C. 100Ω

D. 200Ω

Answer: B

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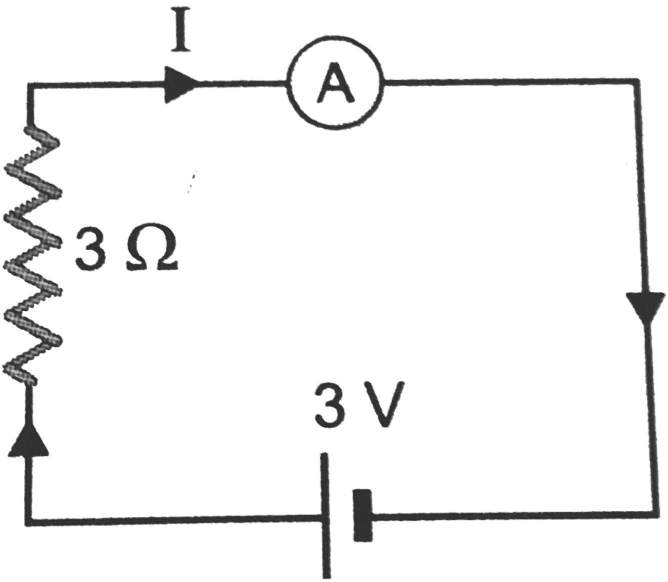
412. In the circuit shown in figure. Ammeter A is a galvanometer of resistance 60Ω shunted with resistance $0 \cdot 02\Omega$. What is the current recorded by ammeter?



A. $0 \cdot 5A$

B. $1 \cdot 0A$

C. $2 \cdot 0A$

D. $10A$

Answer: B

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Test Your Grip (a)

1. Ampere's circuital law can be derived from

A. Ohm's law

B. Biot-Savart's law

C. Kirchhoff's law

D. Gauss's law

Answer: B

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Test Your Grip (c)

1. The structural formula of the ore called natural magnet is

A. FeO_2

B. Fe_3O_4

C. FeO_3

D. Fe_2O_4

Answer: B

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Test Your Grip (d)

1. The SI unit of magnetic permeability is

A. $WbA^{-1}m$

B. $WbA^{-1}m^{-1}$

C. Hm

D. $Tm^{-1}A$

Answer: B

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2. The SI units of magnetising force or magnetising intensity are same as those of

A. magnetic induction

B. intensity of magnetisation

C. magnetic susceptibility

D. none of the above

Answer: B

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3. What are SI units of magnetic susceptibility?

A. Am

B. Am^{-1}

C. Hm^{-1}

D. No units

Answer: D

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4. Name the cgs unit of magnetising intensity. How is it related to SI unit of intensity.

A. $80Am$

B. $80Am^{-1}$

C. $80A^{-1}m$

D. $80A^{-1}m^{-1}$

Answer: B

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5. The magnetic susceptibility of a superconductor is

A. $\chi_m = 1$

B. $\chi_m = -1$

C. $\chi_m = 0$

D. $\chi_m = \infty$

Answer: B

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Fill in the blank (a)

1. The magnetic field is........................around a conductor in which its magnetic effect can be felt.

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2. Static charge is a source of...................but not of................ .

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3. A moving charge is a source of...........................as well as............. .

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4. The magnetic field produced due to current carrying straight solenoid is same as is due to........................ .

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Fill in the blank (b)

1. Cyclotron is suitable only for accelerating........................but not................ .

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2. In moving coil galvanometer, the coil is wound over the...................frame in order to make the galvanometer................ .

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3. The range of ammeter can be.........................but can not be.................... .

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4. The voltmeter of.............................. range has lower resistance than the voltmeter of........................range.

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Fill in the blank (c)

1. A natural magnet has............and.............properties.

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2. Like poles......................each other and.............poles......................each other.

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3. SI unit of magnetic pole strength is

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4. The magnetic field strength at a point due to a bar magnet varies...................as..................of distance of the point from the centre of magnet.

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Competition Focus (Multiple Choice Questions)

1. When a current of 5mA is passed through a galvanometer having a coil of resistance 15Ω, it shows full sacle deflection. The value of the resistance to be put in series with the galvanometer to convert it into a voltmeter of range $0 - 10V$ is:

A. $2 \cdot 535 \times 10^3 \Omega$

B. $4 \cdot 005 \times 10^3 \Omega$

C. $1 \cdot 985 \times 10^3 \Omega$

D. $2 \cdot 045 \times 10^3 \Omega$

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2. In a moving coil galvanometer, there is a coil of copper having number of insulated turns N, each of area A. The coil is suspended in a radial magnetic field B. The moment of inertia of the coil

about its rotational axis is I. The scale divisions in the galvanometer are n and resistance of the coil is R.

The voltage sensitivity of the galvanometer (in rad/volt) is

A. $\frac{\pi}{3R}$

B. $\frac{3i_0R}{\pi}$

C. $\frac{\pi}{3i_0R}$

D. $\frac{\pi}{i_0R}$

Answer: C

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