PHYSICS

BOOKS - CHHAYA PHYSICS (BENGALI ENGLISH)

ELECTROMAGNETISM

Example

1. The distance between two long straight conductors is 5m. Currents $2.5A$ and 5A are

flowing through them in the same direction. What will be the magnetic field at the mid-point betwen them ?

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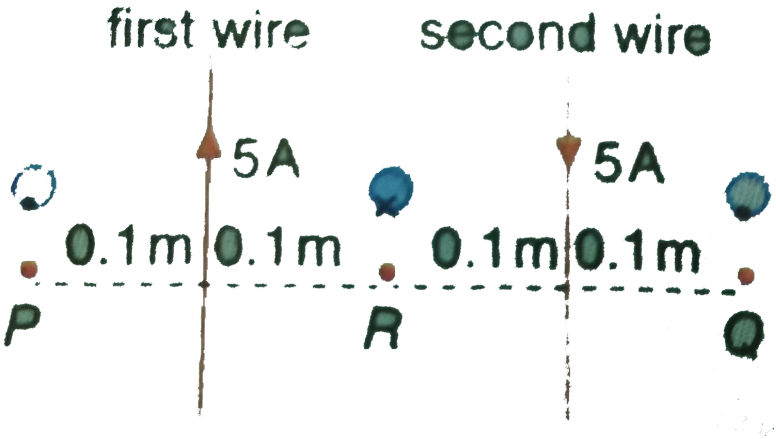
2. 5 A current is flowing is mutually opposite directions through each of two parallel straight conducting wires kept 0.2 m apart (fig1.21). Determine the magnitudes and directions of magnetic field at the points P,Q and R lying on the plane containing the two wires.



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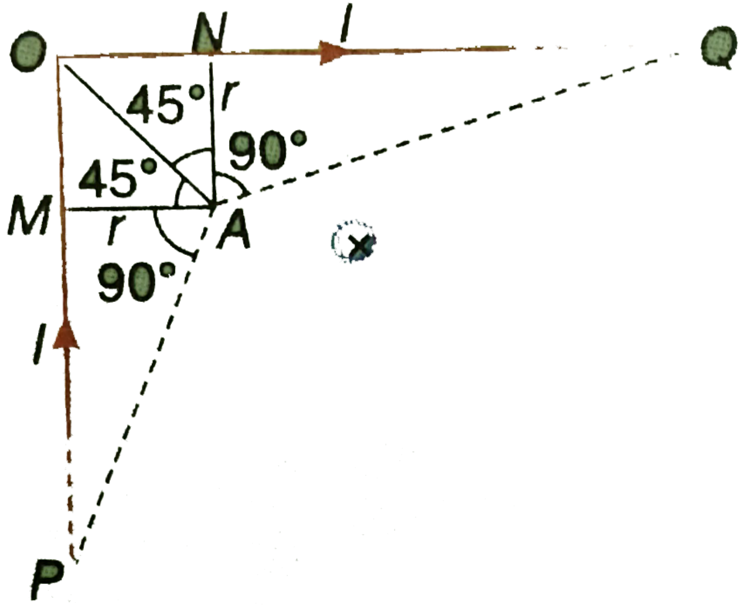
3. An infinitely long conducting wire POQ is bent through right angles at O (Fi,g 1.22]. If a current I is sent through this bent wire, what will be the magnitude of the magnitude of the

magnetic field at the point A at a distance r

from each part of the wire ?



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4. 5 A current is flowing through a long straight conducting wire. What is the magnitude of magnetic field at a distance 10 cm from the wire ?

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5. The radii of two concentric circular coils are 8 cm and 10 cm and the number of turns in them are 40 and 10, respectively. A 5A current is passing through each of them In the direction. Determine the magnetic field produced at the centre of the two coils.

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6. A current I is flowing through an infinitely long wire PQRS [Fig. 1.30]. The wire is bent at right angles so that the part QR becomes one-fourth of the circumference of a circle or radius r whose centre is at O. Determine the magnetic field at O.

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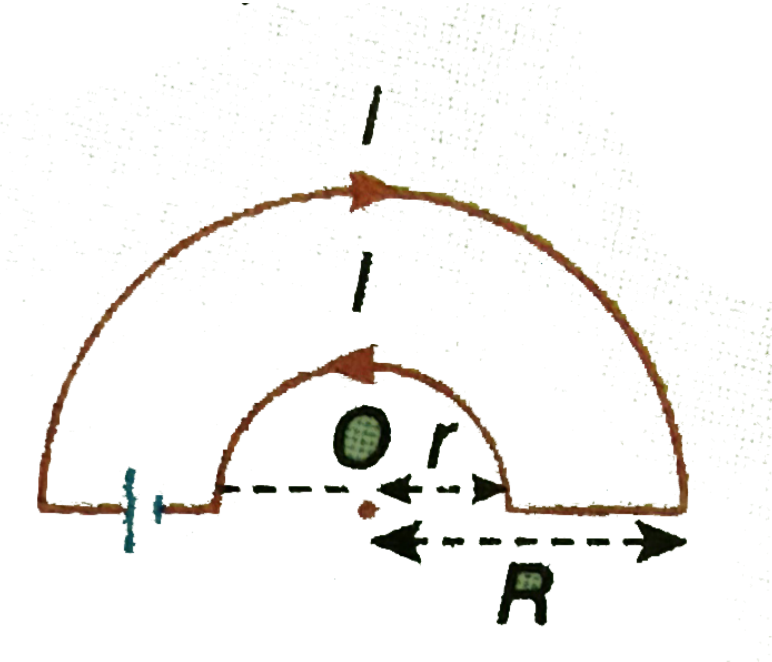
7. Determine the magnetic field at the point O due to the circuit shown in Fig.1.31.



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8. What is the magnetic field produced at the centre of a hydrogen atom due to revolution of its electron in the first order (K-orbit).

Radius of the first orbit $= 0.53 \times 10^{-10} m$, velocity of electron in that orbit $= 2.19 \times 10^{6} m \cdot s^{-1}$.

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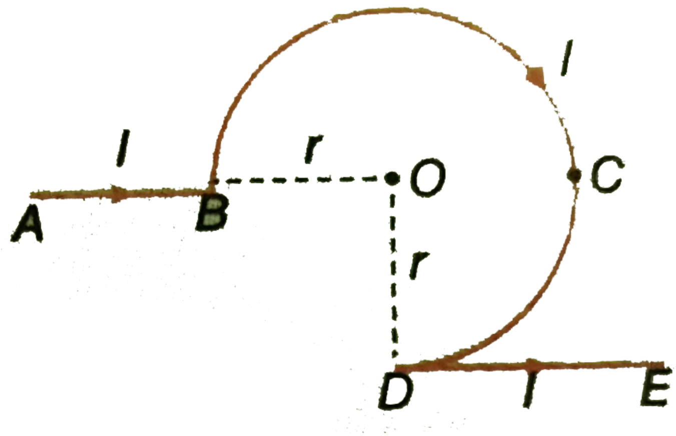
9. Calculate the magnetic induction at point O(centre of the partial circular conductor) show in the figure.



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10. Two concentric but mutually perpendicular conduction coils are carrying current 3A and 4A, respectively . if the radius of each coil be $2\pi, cm$. What will be the magnetic induction at the centre of the coils ?

$(\mu_0 = 4\pi \times 10^{-7} Wb \cdot A^{-1} m^{-1})$.

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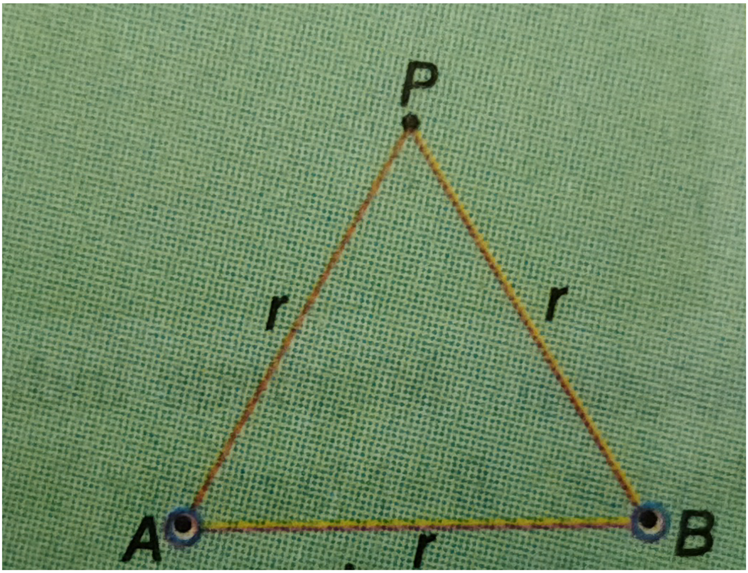
11. Each of the long straight, wires, passing through the points A and B of Fig. 1.33, carries a current I directed vertically upwards with respect to the plane of the paper. The separation between them is r. find out magnetic field at a point P on that plane, which is at a distance r from each of the wires.



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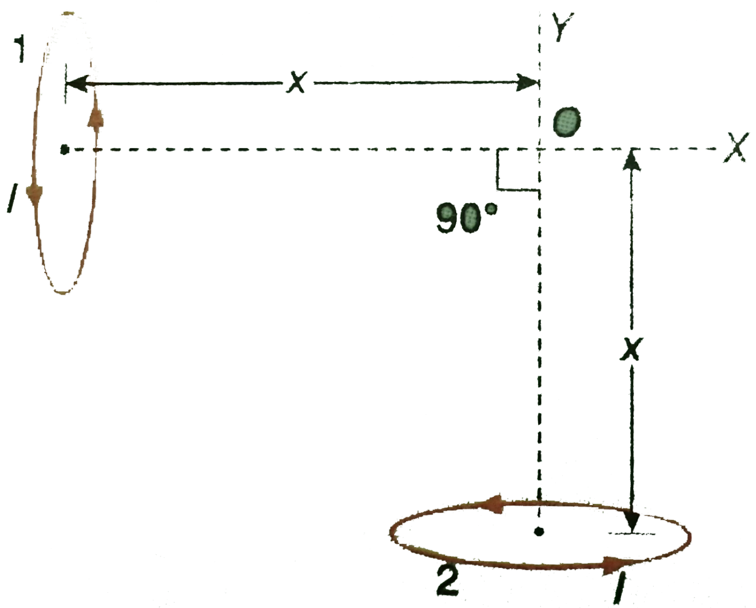
12. Two small identical circular loops marked (1) and (2) carrying equal currents, are placed with their gometrical axes perpendicular to

each other as shown in figure. Find the magnitude and direction of the net magnetic field produced at O. Also determine the field when radius of the loop is very large as compared to the distance of the point from centre.



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13. Two circular coils of radii a and 2a having a common centre, carry identical current I but in opposite directions. Number of turns of the second conductor is 8. show that magnetic field intensity at the centre is 3 times that due to the smaller one. Also find out the change in the previous when current flow in the same direction through both the coils.

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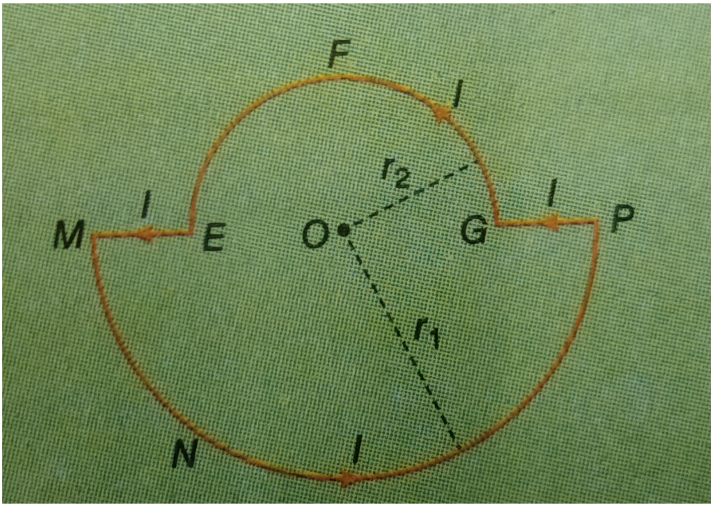
14. A wire loop is formed by joining two semicircular wires or radii r_1 and r_2 as shown in the figure. If the loop caries a current, I, find the magnetic field at the centre O.



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15. Radius and number of turns of a circular coil are 10 cm and 25 respectively. What should be the curcrent through the coil that will produce a magnetic field of $6.28 \times 10^{-5} Wb \cdot m^{-2}$ at its centre ?

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

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17. A solenoid with 7 turns per unit length is carrying a current of $2.5A$. What is the magnetic intensity inside the solenoid ?

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18. Length of a solenoid is 50 cm and its total number of turns is 1250. if 2A current is a passed through it, what will be the magnetic field at any point on its axis ?

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19. Two solenoids made of insulated conducting wires and of equal lengths are such that one is wound over another. Resistance of each of them is R and number of turns per unit lenghts is n. The solenoids are now conected in series and if current flows through them in the same direction in both cases, determine the magnetic field along the axis of solenoids in each case.

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20. Two solenoids made of insulated conducting wires and of equal lengths are such that one is wound over another. Resistance of each of them is R and number of turns per unit lenghts is n. The solenoids are now connected in parallel and the combination is then connected with a battery of emf E. if current flows through them in the same direction in both cases, determine the magnetic field along the axis of solenoids in each case.

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21. A long straight solid conductor of radius 5 cm carries a current of 2A, which is uniformly distributed over its circular cross section. Find the magnetic field at a distance of 3 cm from the axis of the conductor.

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22. A magnetic field of $0.40T$ is applied on a proton moving with a velocity of $5 \times 10^6 m \cdot s^{-1}$. The magnetic field acts at a angle 30° with the direction of velocity of the proton. What will be the acceleration of the proton ? (mass of proton $= 1.6 \times 10^{27} kg)$.

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23. An electron (mass $= 9 \times 10^{-31} kg$, charge= $1.6 \times 10^{-19} C)$ enters a magnetic field with velocity $10^{6} m \cdot s^{-1}$ and starts rotating in a circular path of radius 10 cm. What is the magnetic field ?

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24. Two particles of equal charge are accelerated by applying the same potential

difference and them allowed to enter a uniform magnetic field normally. If the particles keep revolving along circular path of radii R_1 and R_2, determine the ratio of their masses.

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25. In a cyclotron the frequency of alternating current is 12 MHz and the radii of its dee is $0.53m$. What should be the operating magnetic field to accelerate protons ? Given mass of proton $= 1.67 \times 10^{-27}$ kg and charge $= + 1.6 \times 10^{-19} C$.

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26. In a cyclotron the frequency of alternating current is 12 MHz and the radii of its dee is $0.53m$. What is the kinetic energy of the proton beam produced by the cyclotron ? Given mass of proton $= 1.67 \times 10^{-27}$ kg and charge $= + 1.6 \times 10^{-19} C$.

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27. A beam of proton with velocity $4 \times 10^5 m \cdot s^{-1}$ centres a uniform magnetic field of $0.4T$ at an angle of 60° to the magnetic field. Find the radius of the helical path of the proton beam and the time period of revolution. Also find the pitch of helix. Mass of proton $= 1.67 \times 10^{-27} kg$.

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28. 2A current is flowing through a circular coil of radius 10 cm, made of insulated wire and having 100 turns.

If the circular plane of the conductor is kept at right angles to the direction of a magnetic field of $0.2Wb.\,m^{-2}$, determine the force acting on the coil.

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29. 2A current is flowing through a circular coil of radius 10 cm, made of insulated wire and having 100 turns. If the conductor is palced parallel to the magnetic field, determine the torque acting on it.(magnetic field=0.2T)

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30. The radius of a circular coil having 100 turns is 5 cm and a current of $0.5A$ is flowing through this coil. If it is placed in a uniform magnetic field of stregth 0.001 T, then what torque will act on the coil, when the plane of the coil is parallel to the magnetic field,

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31. The radius of a circular coil having 100 turns is 5 cm and a current of $0.5A$ is flowing through this coil. If it is placed in a uniform magnetic field of stregth 0.001 T, then what torque will act on the coil, when the plane of the coil is inclined at 30° with the magnetic field,

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32. The radius of a circular coil having 100 turns is 5 cm and a current of $0.5A$ is flowing through this coil. If it is placed in a uniform magnetic field of stregth 0.001 T, then what torque will act on the coil, when the plane of the coil is perpendicular to the magnetic field ?

33. On a smooth plane inclined at 30° with the horizontal, a thin current carrying metallic rod is placed parallel to the horizontal ground. The plane is in a uniform magnetic field of $0.15T$ alon the vertical direction. For what value of current can the rod remain stationary ? the mass per unit lenght of the rod is 0.30 kg/m.

34. Two very long conducting wire are kept at a distance 4 cm from each other in vacuum. Currents flowing through the wires are 25A and 5A, respectively. Find the length of each conductor, which experiences a force of 125 dynes ?

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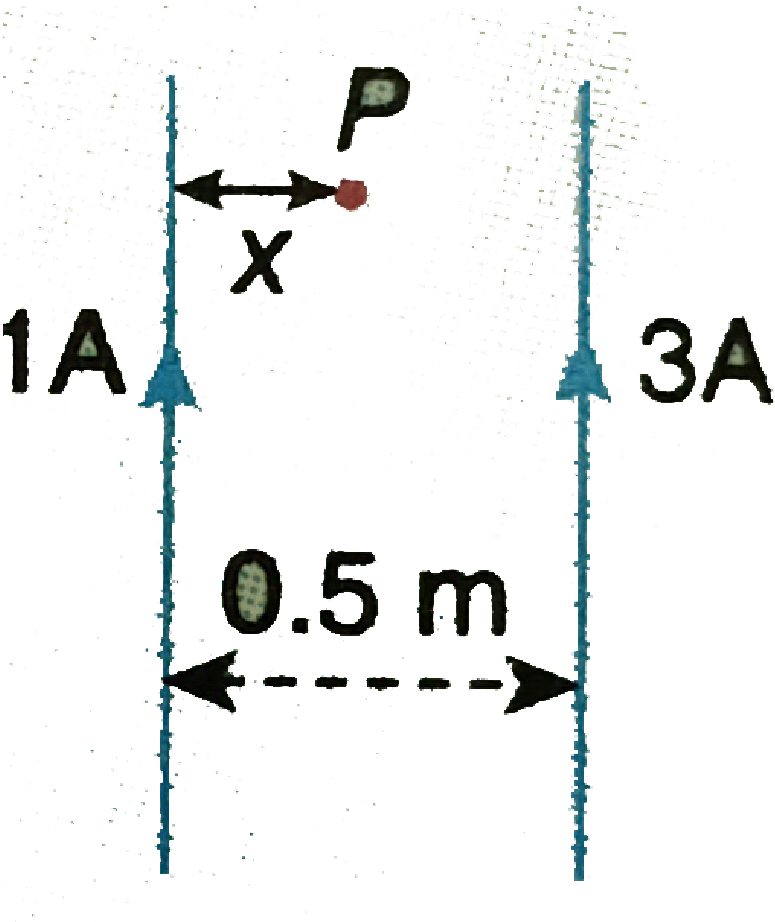
35. Two long striaght parallel conducting wires, kept 0.5 apart, carry 1A and 3A currents, respectively [Fig. 1.73].

What is the force acting per unit length of the two wires ?



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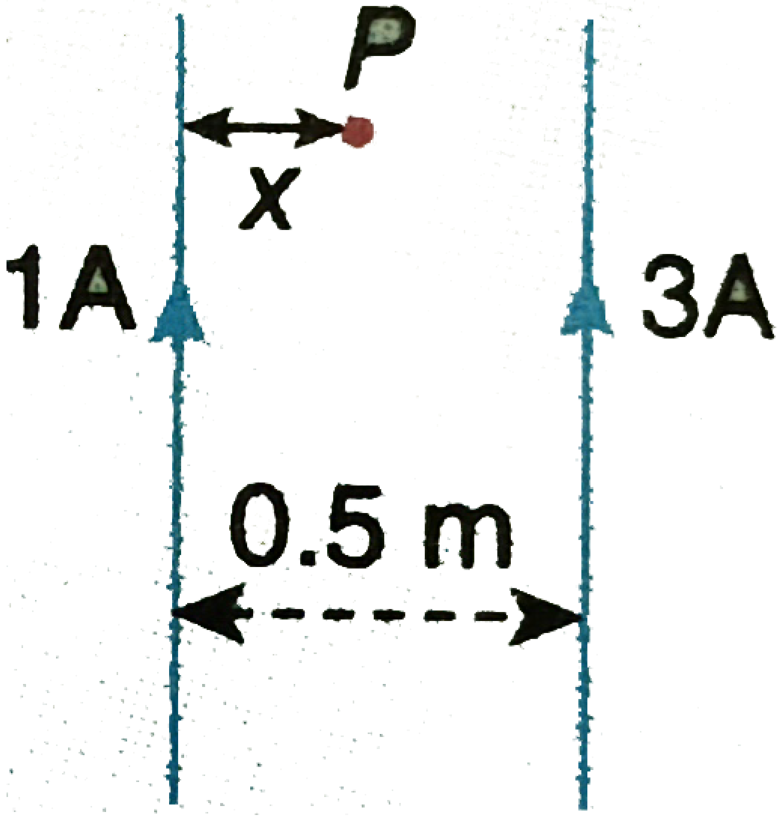
36. Two long striaght parallel conducting wires, kept 0.5 apart, carry 1A and 3A currents, respectively [Fig. 1.73].

At what position in the plane of the wires, the resultant magnetic field will be zeron ?



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37. Two long parallel conductors, kept at a dsitance d, carry currents I_1 and I_2 respectively. The mutual force acting between them is F. now the current in one is doubled and its direction is also reversed. If the distance of seperation between them is made 3d, what will be the force acting between the two conductors ?

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38. A long horizontal wire AB, which is free to move in a vertical plane and carries a steady current of 20 A, is in equilibibirum at a height of 0.01 m over another parallel long wire CD, which is fixed in a horizontal plane and carries a steady current of 30 A as shown in figure. Show that when AB is slightly depressed, it executes simple harmonic motion. Find its period of oscillations.

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39. A galvanometer of resistance 10Ω gives full scale deflection for current of 10 mA. How can this galvanometer be used as an ammeter of merasure current of range $0 - 2A$

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40. A galvanometer of resistance 10Ω gives full scale deflection for current of 10 mA. How can this galvanometer be used as a voltmeter having volage range $0-5V$?

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41. Full-scale deflection occurs in a moving coil galavanometer of resistance 36Ω when 100 mA current flows through it. What arrangement should be done to convet it into a voltmeter of $0 - 5V$ range ? Draw the ncessary circuit diagram.

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42. A millivoltmeter of range $0 - 50$ mV and resistance 50Ω is to be converted into an ammeter of range $0 - 1A$. How much it be done ?

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43. How would you convert a voltmeter that can measure up to 150 V to an ammeter which can measure current up to 8A ? Resistance of the voltmeter is 300Ω.

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44. A galvanomter of resistance 100Ω gives full scale deflection for a current of 10 mA. What is the value of the shunt to be used to convert it into an ammeter which can measure current up to 10A ?

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45. A moving coil galvanometer of resistance 50Ω gives full scale deflection for a current of 50 mA. How can this galvanometer be used to convert it into a voltmeter which can measure voltage upto 200 V ?

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Section Related Questions

1. What are the fundamental properties of a magnet ?

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2. What do you mean by natural magnet ?

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3. Give some example of artificial magnets.

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4. Define magnetic poles and magnetic axis.

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5. Repulsion is the conclusive test of magnetisation explain.

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6. Define magnetic lines of force.

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7. How can a uniform magnetic field be denoted by magnetic lines of force ? Why

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8. How are the magnitude and direction of magnetic field at a point denoted by the magnetic lines of force ?

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9. Write down the properties of the magnetic lines of force.

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10. Write down Ampere's swimming rule related to the deflection of magnetic needle kept near a current carrying conducting wire.

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11. State the rule for the determination of the direction of magnetic field in the vicinity of a current carrying wire.

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12. How would you draw diagram of the magnetic lines of force produced due to flow of electric current through a straight conductor and indicate the directions of current and magnetic lines of force in that diagram.

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13. Show with the help of a diagram the nature of the magnetic lines of force normal to the plane of current carrying circular coil.

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14. State Biot-Savart law (Laplace' law) related to the magnetic field produced due to current flow through a conductor.

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15. What do you know about the magnetic permeability vaccum ?

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16. Write down Biot-Savart law in vector from with an accompanying diagram.

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17. Write down (a) the mathematical expression of Biot-Savart law, (b) the significances of the symbols used, (c) the unit of magnetic induction B.

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18. Determine the magnetic induction at the centre of a circular coil of radius r carrying a current I with the help of the Biot-Savart law.

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19. Determine the magnetic field in the following cases applying Biot-Savart law :

at a distance r from an infinitely long straight wire.

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20. Determine the magnetic field in the following cases applying Biot-Savart law :

at the centre of a current carrying circular loop.

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21. Using Bio-Savart law determine the magnetic field at any point on the axis of a current carrying circular loop.

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22. Using Bio-Savart law, find out the magnitude of the mangnetic field at an external point due to a current flowing through an infinitely long straight wire. Sketch the field lines in the neighbourhood of the wire.

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23. State Ampere's circuital law. With the help of this law determine the magnetic field at an internal point of a long solenoid.

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24. state ampere's circuital law.

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25. Describe with a diagram how magnetic field is generated inside a solenoid due to current passing through it.

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26. Draw magnetic field lines to demonstrate that a current carrying solenoid and a bar magnet are equivalent.

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27. State Ampere's circuital law and apply it to obtain the magnetic field intensity a toroidal solenoid.

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28. Write down the vertorial expression for the force exerted on a charged particle moving in a magnetic field.

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29. Define magnitude and direction $\vec{B}$ in a magnetic field.

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30. Define the unit of magnetic field $\overrightarrow{B}$.

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31. Work done by magnetic force is zero. Explain.

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32. Derive fleming's left rule related to the direction of force acting on a charge particle moving perpendicular to the magnetic field.

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33. Calculate the force acting on a current carrying conductor in magnetic field.

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34. A particle having q enters a magnetic field with a velocity $\overrightarrow{v}$ in the direction normal to the field. Determine the radius of the circular path described by the particle and its frequency of rotation.

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35. A particle carrying charge q enters a uniform magnetic field $\overrightarrow{B}$ with velocity $\overrightarrow{v}$. Discuss the nature of the path described by the particle in each of the following cases, when $\overrightarrow{v}$ and $\overrightarrow{B}$ are parallel to each other,

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36. A particle carrying charge q enters a uniform magnetic field $\vec{B}$ with velocity $\vec{v}$. Discuss the nature of the path described by the particle in each of the following cases, when $\vec{v}$ and $\vec{B}$ are are inclined at any angle.

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37. A particle with charge q moves with velocity $\vec{v}$ in a direction perpendicular to the magnetic field lines. What would be the direction of force experienced by the particle ?

What is the nature of the path described by the particle ? Find the cyclotron Frequency.

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38. When a particle carrying charge q enters a unifrom electric field with a velocity $\vec{v}$ normal to the field, the nature of the path of that particle becomes parabolic-discuss.

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39. In a region, electric field $\overrightarrow{E}$ and magnetic field $\overrightarrow{B}$ are mutually perpendicular. If a partical of charge q enters that region with velocity $\overrightarrow{v}$ normal to both the fields, under what condition does the direction of motion of the particle remain unchanged ?

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40. What is Lorentz force ? Write down its expression.

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41. What will be force acting on a charge moving in a uniform magnetic field and a uniform electric field at the same time ? In which cases, will this force the maximum and minimum ? Discuss.

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42. What is cyclotron ? Establish its resonance condition.

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43. What is the use of a cyclotron?

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44. Discuss briefly the working principle of a cyclotron.

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45. Find out the kinetic energy of a charged particle emerging from a cyclotron.

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46. An electron and proton revolve along circular paths of the same radius perpendicular to an applied magnetic field. Compare their kinetic energies.

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47. Obtain an expression for the force acting on a conductor placed in a magnetic field.

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48. State Fleming's left hand rule related with the force acting on a conductor placed normally with the direction of a magnetic field.

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49. Explain the working principle of a Barlow's wheel.

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50. Obtain an expression for the torque acting on a current carrying rectangular coil placed in a uniform magnetic field when the plane of the coils is parallel to the magnetic lines of force.

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51. On which factors does the speed of rotation of a Barlow's wheel depend ?

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52. Calculate the torque acting on a rectangular coil carrying current I placed in a uniform magnetic field when the plane of the coil is perpendicular to the magnetic lines of force.

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53. What kind of force acts between to like parallel current and Write down the expresion for the magnitude of this force.

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54. What kind of force acts between to unlike parallel currents ? Write down the expression for the magnitude of this force.

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55. Current i_1 and i_2 are flowing in the same direction through tow long parallel wires kept at a distance d apart. Determine the expression for the force acting per unit length of the wires. Define 1A current from It.

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56. Two parallel conductors carrying currents in the same direction attract each other-explain with reason.

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57. Discuss the working principle of a moving coil galvanometer.

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58. Write down the condition of sensitivity of D' Arsonval galvanomenter.

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59. Draw a circuit diagram showing the use of an ammeter and a voltmeter.

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60. State the differences between an ammeter and a voltmeter.

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61. Why should the reistance of an ammeter be as low as possible whereas that of voltmeter be as high a possible ?

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62. If a galvanometer is converted into an ammeter by using a shunt, determine the relation between the ammeter current and the galvanometer current with the help of a circuit diagram. What kind of galvanometer is used for this ?

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63. Show that , if the range of an ammeter is increases n times, its resistance decreases n times.

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64. Show that , if the range of a voltmeter is increases n times, its resistance also increases n times.

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Higher Order Thinking Skill Hots Questions

1. State whether the mutual distances between the circular magnetic lines of force obtained on a plane, perpendicular to a straight long current carrying wire would be the same or not ?

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2. A mangnet and a charged particle are placed near each other. State whether a force will act on the charged particle if both the magnet and the charged particle are rest

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3. A mangnet and a charged particle are placed near each other. State whether a force will act on the charged particle if both travel with equal velocity,

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4. A mangnet and a charged particle are placed near each other. State whether a force will act on the charged particle if the magnet is moving but the charged particle is at rest,

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5. A mangnet and a charged particle are placed near each other. State whether a force will act on the charged particle if the magnet is at rest but the charged particle is in motion

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6. Current is flowing in a long, striaght conductor passing through the axis of a circular coil carrying current. What will be the mutual force acting between them ?

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7. An electron and a proton are revolving along circular paths of equal radii and equal magnetic fields. Compare their kinetic energies.

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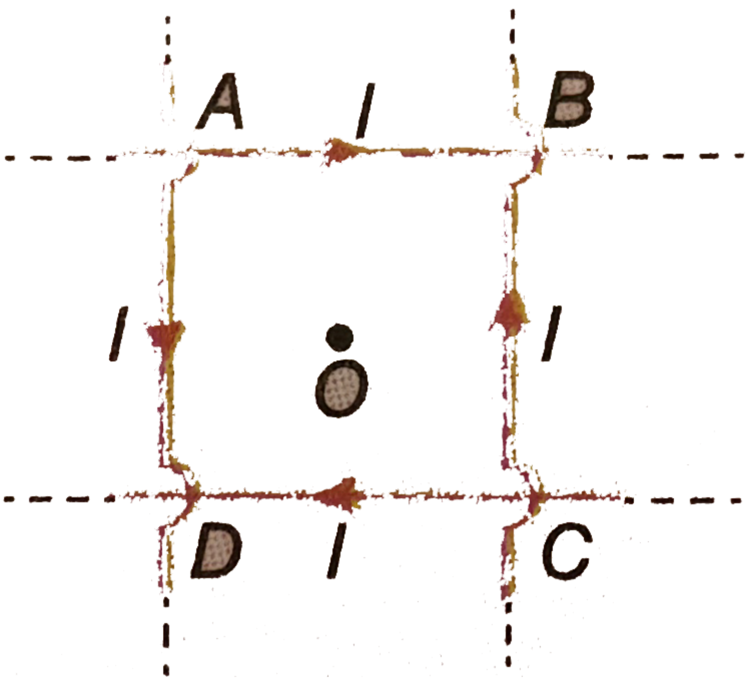
8. Four wires of inifinte lengths are palced on a plane as show in Fig. 1.83. The same current I is flowing through each of the wires, Determine the resultant magnetic field at the centre O of the square ABCD. Explain with reason briefly.



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9. When a charged particle moves through a particular region it is not deflected. From ths, can it be inferred that no magnetic field is present in that region ?

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10. A charged particle is released from rest in a region of steady and uniform electric and magnetic fields, which are parallel to each other. What will be the nature of the path followed by the charged aprticle ?

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11. An electron is not deflected in passing through a certain region of space. Can we be sure that there is no magnetic field in that region ?

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12. Equal currents are flowing through two infinitely long conducting wires. State whether a magnetic field will exist at a point midway between the wires if they carry current in the same direction and

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13. Equal currents are flowing throgh two infinitely long conducting wires. State whether a magnetic field will exist at a point midway between the wires if they carry current in the opposite direction ?

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

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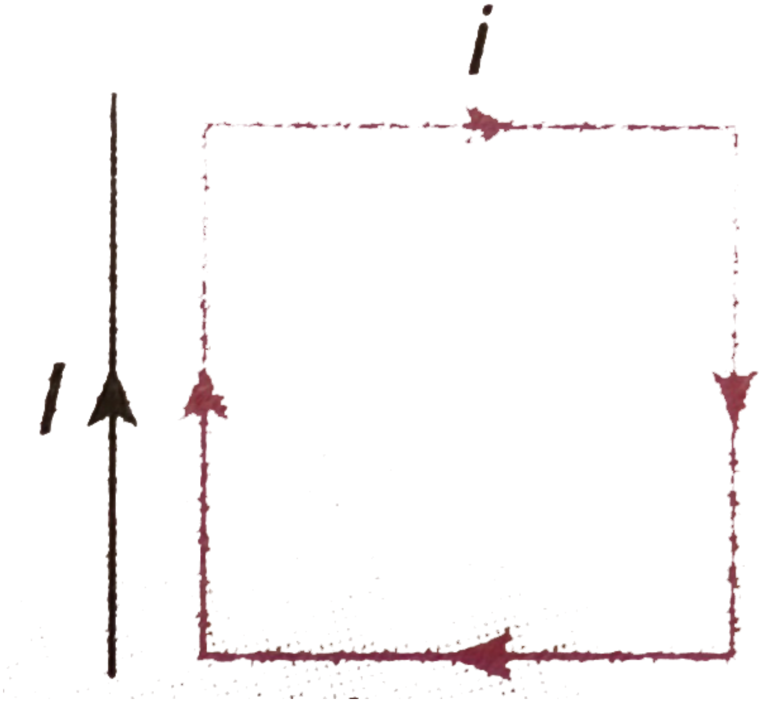
15. A recatangular loop carrying a current I is placed near a long straight wire in such way that the wire is parallel to one of the sides of the loop an in the plane of the loop. If a steady current I is passed through the wire as shown in Fig 1.84, then the loop (A) will rotate about an axis parallel to the wire (B) will move away from the wire (C) will move towards the wire (D) will remain stationary. Chosse the correct alternative.



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16. A steady current is flowing through a long wire. If it is converted into a single turn circular coil, the magnetic field produced at its is B. Now it is converted into a circular coil having n tunrs. What will be the magnetic field at the centre of the coil ?

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17. A recatangular loop made of a very thin and flexible wire is kept on a table. The two ends of the wire are connected with two joining screws and a high directe current is allowed to pass through the wire. What will be the shape of the wire and why ?

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18. In a region, a uniform electric field and a uniform magnetic field are acting in the same direction. An electron is shot along the directio of the fields. What change will be observed in the magnitude and direction of the velocity of that electron ?

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19. Two wires of equal length of bent in the form of two loops of one turne each. One of them is square shaped, whereas the other in circular. Both of them are suspended in a uniform magnetic field. When the same current is passed throgh them, which one will experience greater torque ?

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20. A circular conducting loop of radius r carrying a current I is placed in a magnetic field $\vec{B}$ in such a way that the plan of the loop is perpendicular to $\vec{B}$. What will be the magnitude of the magnetic forces exerted on the loop ?

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21. The ratios of the masses and charges of a proton and an alpha particle are respectiely

$1:4$ and $1:2$. They enter a uniform magnetic field of magnitude B normally with same velocity. What will be the ratio of the radii of the circular paths described by the particles in each case ?

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22. The ratio of the masses and charges of a proton and an alpha particle are respectively $1:4$ and $1:2$. They enter a uniform magnetic field of magnitude B normally with same momentum and What will be the ratio of the radii of the circular paths described by the particles in each case ?

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23. The ratio of the masses and charges of a proton and an alpha particle are respectiely $1:4$ and $1:2$. They enter a uniform magnetic field of magnitude B normally with same kinetic energy. What will be the ratio of the radii of the circular paths described by the particles in each case ?

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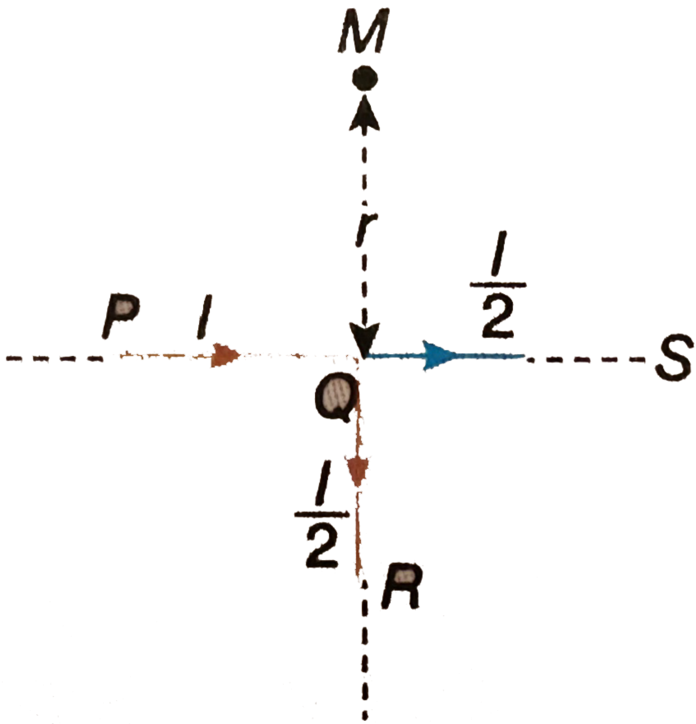
24. If current I passes through an infinitely lon wire PQR ben at right-angle at Q,then magnetic field at the poin M is H_1 [Fig. 1.87] . No another wire is joined along QS in such a manner that the currents along PQ, QR and QS are $I, \frac{1}{2}$ and $\frac{1}{2}$, respectively. Now, if the magnetic field at the point M be H_2, find the value of $\dfrac{H_1}{H_2}$



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25. If current I passes through a square-shaped conducting loop of side a, what is the value of the magnetic field at the point of intersection of its two diagonals ?

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26. If the current through a conducting loop in the shape of an equilaterla triangle of side a be I, what will be the magnitude of the magnetic field of intersection of the three medians ?

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27. Due to flow of current I through a square shaped conducting loop, magnetic field generated at its centre is B. the magnetic field generated at the centre of a circular conducting loop having the same perimeter as that of the square and for the flow of the same current is B'. determine the ratio of B to B'.

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28. Radius of the circular path of a revolving electron (cahrge=-e) around the nucleous is r. due to this revolution, magnetic field generated at the nucleus is B. What is the angular velocity of the electron ?

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29. An electron (mass m, charge -e), accelerated through a potential difference V, enters normally a uniform magnetic field B.

What will be the radius of the circular motion of the electron ?

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30. To detect whether current is flowing in a wire or not, the wire is brought near a magnetic needle but the needle shows no deflection. But then the wire is immersed in water kept in a calorimeter, the water gets heated. How could you explain this ?

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31. An α particle and a proton are moving in the plane of a paper in a region where there is uniform, magnetic field directed normal to the plane. If two particels have equal linear momenta, what will be the ratio of the radii of their trajectories in the field ?

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32. If a particle of charge q is moving with velocity $\overrightarrow{v}$ along y axis and a magnetic field $\overrightarrow{b}$

act along z axis, find the force acting on it. What happens to its kinetic energy ? Justify.

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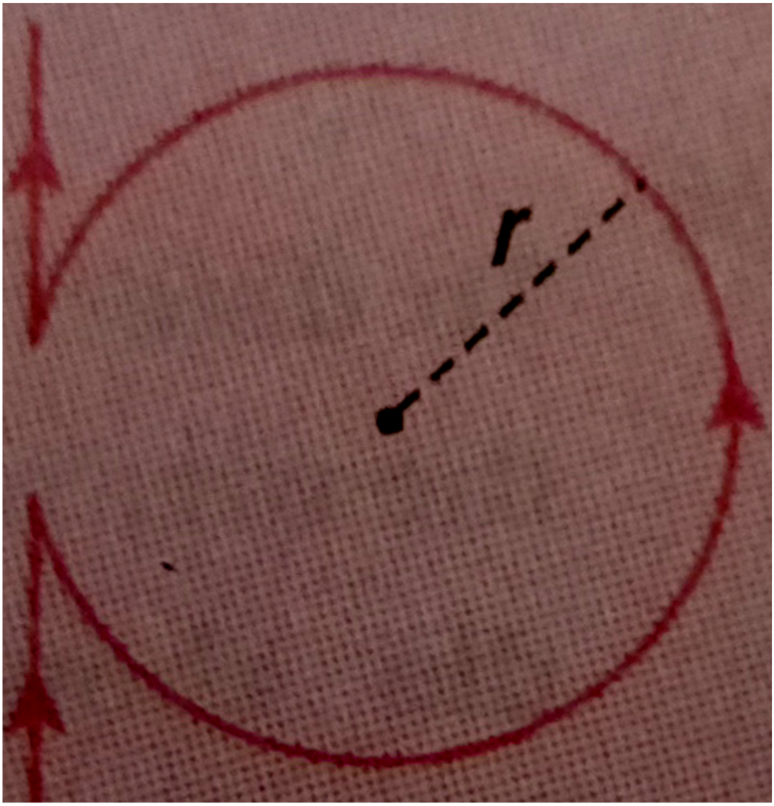
33. A circular loop of radius r is formed by bending some portion of an infinitely long wire [Fig. 1.90] . If a current I flows through the wire, what will be the magnetic field at the centre of the circle ?



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34. State the nature of the graph showing the change of magnetic field with the perpendicular distance from an infinitely long wire carrying a steady current.

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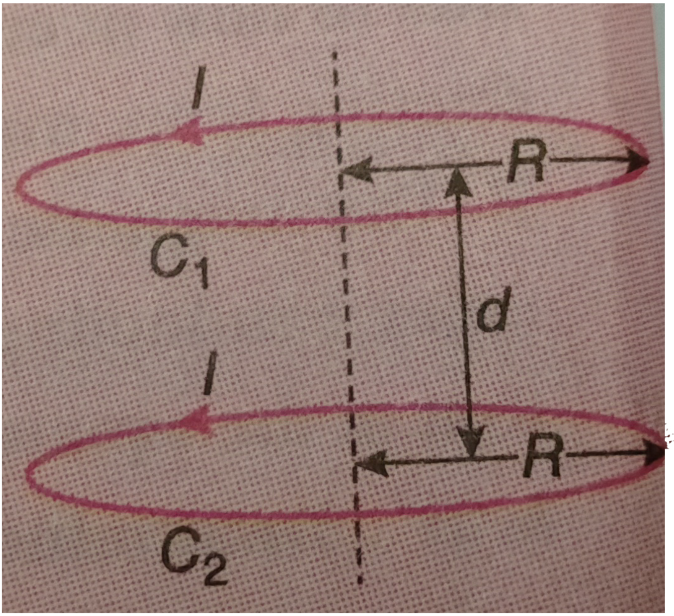
35. Determine the force between two parallel circular coaxial coils of radius R each, which are a small distance $d(d < < R)$ apart in free space and carry indentical currents I.

Assume that each of the coils has a single turn.



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36. A particle of mass m and charge q moves with a constant velocity v along the positive x-direction. If entres a region of uniform magnetic field B directed alon the negative z-direction and extanding from $x = a$ to $x = b$. Find the minimum value of v so that the particle can just enter the region $x > b$.

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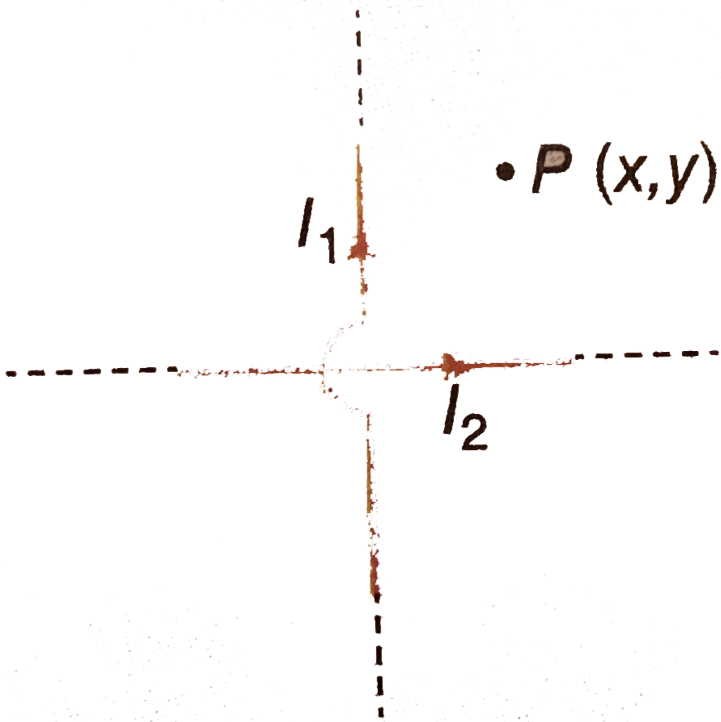
37. Two insulated infinitely long wires are lying mutually perpendicular to each other as shown in the figure. If the two wires carry currents I_1 and I_2 find the locus of the point, where the magnetic field due to the two wires is zero.



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38. Any two points on the circumference of uniform circular conductor are connected to

the terminals of a cell. Show that, the resultant magnetic field at the centre of the circle is zero.

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39. Write down the differences between electric lines of force and magnetic lines of force.

Watch Video Solution

40. 'Increasing the current sensitivity of galvanometer may not necessarily increases its voltage sensitivity". Justify this statement.

Watch Video Solution

41. Range of an ammeter is increases by n times. What is the change in its resistance ?

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42. What is the change in resistance of a Voltemter if its range is increases by n times ?

Watch Video Solution

43. If the distance x of a point on the axis of a circular loop carrying current I is much larger than the radius of the loop, show that the magnetic field at that points is proportional to $\frac{1}{x^3}$.

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44. Two wires of equal length are bent in the from of two loops. One of the loops is a square wheres 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 ?

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45. A rectangular coil carrying current I is placed in a uniform magnetic field B such that the direction of B is perpendicular to the plane of the coil. Calculate the torque experienced by the coil.

Watch Video Solution

46. Find the magnetic field at the point of intersection of the diagonals of a square having sides a and carrying current I.

Watch Video Solution

47. A charged particle enters a uniform magnetic field perpendicularly and experiences a force F. if the kintetic energy of the particle is doubled, then what will be the force on that particles ?

Watch Video Solution

48. Two equally charged positive ions of Ne^{20} and Ne^{22} atom enters a uniform magnetic field perpendicular to the lines of force. Which one trajectory will have a larger radius of c urvatures ?

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Ncert Textbook Questions With Answer Hint

1. Two moving coils meters M_1 and M_2 have the following particulars :

Resistance	$R_1 = 10\ \Omega$	$R_2 = 14\ \Omega$
No. of turns	$N_1 = 30$	$N_2 = 42$
Area of the coil	$A_1 = 3.6 \times 10^{-3} m^2$	$A_2 = 1.8 \times 10^{-3} m^2$
Magnetic field	$B_1 = 0.25\ T$	$B_2 = 0.50\ T$

(The spring constancs are identical for the two meters).

View Text Solution

2. Voltage sensitivity of M_2 and M_1.

View Text Solution

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

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4. Would your answer change, if the circular coil (A) were replaced the same a planar coil of some irregular shape that enclose the same area (All other particules are unlatered.)

View Text Solution

5. Two concentric circular coild X and Y or radii 16 cm and 10 cm, respectively, lie in the same vertical plane oriented along the north to south direction. Coil X has 20 turns and carris a current of 18A. The sense of the current in X is anticlockwise and in Y is clockwise, for an observer looking at the coils facing west. Give the magnitude and direction of the net magnetic field due to the coils at their centre.

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6. A uniform magnetic field of 100 G $(IG = 10^{-4}T)$ exists in a region of length about 10 cm 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 turns m^{-1}. How would you utils the coil to design a solenoid for the required purpose ? Assume the core is not ferromagnetic.

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7. For a circular coil of radius R and number of turns N carrying a current I, the magnitude of the magnetic field at a point on its axis at a distance x from its centre is given by

$$B = \frac{\mu_0 I R^2 N}{2(x^2 + R^2)^{3/2}}$$

Consider two parallel co-axis circular coils of equal radius R and number of turns N, carrying equal current 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 compared to R and is given by $B = 0.72\mu_0 NI / R$, approximately.

(Such an arrangement to produce a nearly uniform magnetic field over a small region is know as Helmholtz coils).

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8. 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 to initial speed if it suffered no collision in the environment ?

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9. An electron travelling west to east enters a chamber having u uniform electrostatic field in the north to south direction. Specify the direction in which a uniform magnetic field should be set up to prevent the electron from deflection from is straight line path.

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10. An electron emitted by a heated cathode and accelerted through a potential difference of $2.\ Kv,$ enters a region of uniform magnetic field of $0.15T$. Determine the trajectory of the electron if the field is transverse to its invial velocity

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11. An electron emitted by a heated cathode and accelerted through a potential difference of $2.\ Kv$, enters a region of uniform magnetic field of $0.15T$. Determine the trajectory of the electron if the field makes an angle 30° with the initial velocity.

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12. A magnetic field, set up using Helmhotlz coils, is uniform, in a small region and has a

magnitude of $0.75t$. 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 (sinle species) charged particles, all accelerated through 15KV, enters this region in direction perpendicular to both the axis of the coils and the electrostatic field. if the beam remains undeflected when the electrostatic field is $9.0 \times 10^5 V \cdot m^{-1}$, make a simple guess as to what the beam contains. Why is the answer not unique ?

Watch Video Solution

13. A straight horizontal conducrting rod of length $0.45m$ and mass 60g is suspended by two vertical wires at its ends. A current of `5.0A is set up in the rod through the wires.

What magnetic field should be set up nromal to the conductor in order that the tension in the wires is zero ?

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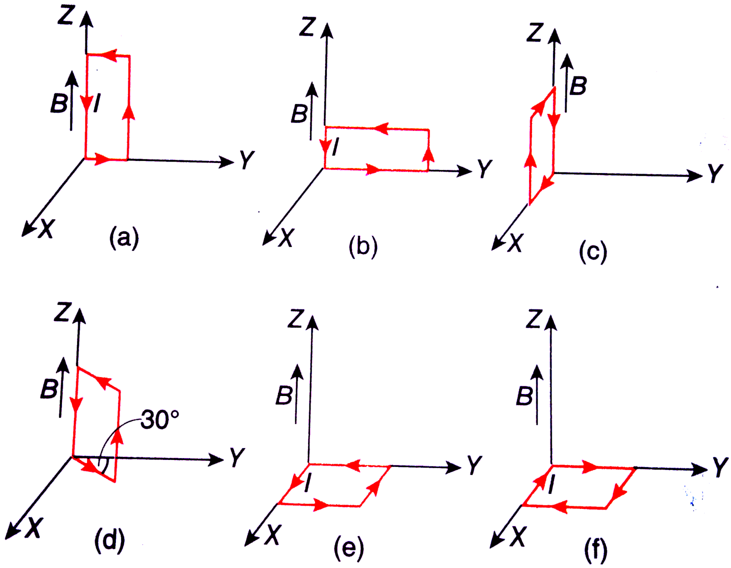
14. A straight horizontal conducrting rod of length $0.45m$ and mass 60g is suspended by two vertical wires at its ends. A current of $5.0A$ is set up in the rod through the wires.

What will be the total tension in the wires the direction of current is reversed keeping the magnetic field the same as before ? (Ignor the mass of th wires $g = 9.8m \cdot s^{-2}$.

Watch Video Solution

15. A uniform magnetic field of 3000G is established along the positive z-direction . A rectangular loop of sides 10 cm and 5 cm carries a current of 12A. What is the torque on the loop in the different cases show in Fig 1.97 ? Which case corresponds to stable equilibrium ?



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16. A 60 cm long solenoid of radius $4.0 cm$ has 3 layers of windings of 300 turns each. A.2.0 cm long wire of mass 2.5g lies inside the

solenoid (near its centre) normal to its 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 the solenoid to an external battery which supplies a current of 6.0A in the wire. What value of current (with appropriate sense of circulation) in the windling of the solenoid can support the weight of the wire ? $g = 9.8 m \cdot s^{-2}$.

Watch Video Solution

17. Two long and parallel stright A and B carrying currents of $8.0A$ and $5.0A$ in the same direction are separted by a distance of $4.0cm$. Estimate the force on a 10 cm section of wire A.

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18. A uniforme magnetic field of $1.5T$ exists in a cylindrical region of radius $10.0cm$. Its direction parallel to te axis along east to west.

A wire carrying current of $7.0a$. In the north to south direction passes through this region. What is the magnitude and direction of the force on the wire if,

the wire intersects the axis

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19. A uniforme magnetic field of $1.5T$ exists in a cylindrical region of radius $10.0cm$. Its direction parallel to te axis along east to west. A wire carrying current of $7.0a$. In the north to south direction passes through this region. What is the magnitude and direction of the force on the wire if,

the wire is turned from N-S to northeast-northwest direction.

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20. A uniforme magnetic field of $1.5T$ exists in a cylindrical region of radius $10.0cm$. Its direction parallel to te axis along east to west. A wire carrying current of $7.0a$. In the north to south direction passes through this region. What is the magnitude and direction of the force on the wire if,

that wire in the N-S direction is lowered from the axis by a distance of $6.0cm$.

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21. A square coils of side 10 cm consists of 20 turns and carries a current of 12A. The coil is suspended vertically and the 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 to torque experienced by the coil ?

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22. A toroid has a core(non-ferromagnetic) of inner radius 25 cm and outer radius 26cm, around which 3500 turns of a wire wound. If the current in the wires is 11A, what is the magnetic field outside the toroid,

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23. A toroid has a core(non-ferromagnetic) of inner radius 25 cm and outer radius 26cm, around which 3500 turns of a wire wound. If the current in the wires is 11A, what is the magnetic field inside the core of the toroid, and

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24. A toroid has a core(non-ferromagnetic) of inner radius 25 cm and outer radius 26cm, around which 3500 turns of a wire wound. If the current in the wires is 11A, what is the magnetic field in the empty space surrounded by the toroid.

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25. A closely wound solenoid 80 cm long has 5 layes of windings of 400 turns each. The diameter of the solenoid is 1.8 cm. if the current carried is $8.0A$, estimate the magnitude of B inside the solenoid near its centre.

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Ncert Examplar Questions With Answer Hint Mcq 1

1. Two charged particles traverses indentical helical paths in a completely opposite sense in a uniform magnetic field, $\overrightarrow{B} = B_0 \widehat{K}$.

A. they have equal z-componenets of momenta

B. they must have equal charge

C. they necessarily represent a particle-antipartile pair

D. the charge to mass ratio satisfy $\left(\frac{q}{m}\right)_1 + \left(\frac{q}{m}\right)_2 = 0$

Answer: D

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2. An electron is projected with uniform velocity along the axis of a current carrying long solneoid. Which one of the following is true ?

A. the electron will be accelerated along the axis

B. the electron path will be circular about axis

C. the electron will experience a force at 45° to the exis and execute a helical path

D. the electron will conitnue to move with uniform velocity along the axis of the soleoid

Answer: D

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Ncert Examplar Questions With Answer Hint Mcq 2

1. Consider a wire carrying a steady current I placed in a uniform magnetic field $\overrightarrow{B}$. Consider the charges inside the wire. It is known that magnetic forces do no work. This implies that

A. motion of charges inside the wire move the surface as a result of $\overrightarrow{B}$.

B. some charges inside the wire move the surface as a result of $\overrightarrow{B}$.

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 worik is done by the magnetic force on the ions, assumed fixed within the wire.

Answer: B::D

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2. 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 $\overrightarrow{v}$ and a position enters via opposite face with velocity $-\overrightarrow{v}$. At this instant,

A. the electric forces on both the particles cause indentical accelerations

B. the mangetic forces on both the particles cause equal acceleration

C. both the particles gain or loose energy at the same rate

D. the motion of the centre of mass determined by $\overrightarrow{B}$ alone

Answer: B::C::D

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3. A charged particle would continue to move with a constant velocity in a region where.

A. $\overrightarrow{E}=\overrightarrow{0},\overrightarrow{B}\neq\overrightarrow{0}$

B. $\overrightarrow{E}\neq\overrightarrow{0},\overrightarrow{B}\neq\overrightarrow{0}$

C. $\overrightarrow{E}\neq\overrightarrow{0},\overrightarrow{B}=\overrightarrow{0}$

D. $\overrightarrow{E}=\overrightarrow{0},\overrightarrow{B}=\overrightarrow{0}$

Answer: A::B::D

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4. Two indentical current carrying coaxial loops, carry current I in an opposite sense. A simple amperian loop passes through both of then once. Calling the loop as C,

A. $\oint_C \vec{B} \cdot d\vec{l} = \pm 2\mu_0 I$

B. the value of $\oint_C \vec{B} \cdot d\vec{l}$ is independent of the shape of C

C. there may bea 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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Exercise

1. Which of the properties of an isolated north pole, placed at a point in a magnetic field, is characterised by the direction of the tangent on the magnetic line of force passing through that point?

A. position

B. displacement

C. velocity

D. acceleration

Answer:

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2. Magnetic flux is defined as

A. the number of magnetic lines of force passing through a surface

B. the number of magnetic lines of force passing normally through a surface

C. the number of magnetic lines of force passing normally through unit area of a surface

D. the number of magnetic lines of force passing through unit area of a surface

Answer:

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3. Current I is flowing through a vertical long wire in the upward direction. The magnetic field at a point on the east of the wire is

A. upwards

B. towards north

C. towards south

D. towards west

Answer:

Watch Video Solution

4. A current of 1 A is flowing through a circular coil of radius 10 cm having N turns. If the magnetic field produced at the centre of the coil be $4\pi \times 10^{-6} T$, what is the value of N ?

A. 20

B. 10

C. 2

D. 1

Answer:

Watch Video Solution

5. Which one of the following relations expresses Biot-Savart law ?

A. $d\overrightarrow{B} = \frac{\mu_0 I}{4\pi} \cdot \frac{dl \times \overrightarrow{r}}{r^2}$

B. $d\overrightarrow{B} = \frac{\mu_0 I}{4\pi} \cdot \frac{d\overrightarrow{l} \times \overrightarrow{r}}{r^3}$

C. $d\overrightarrow{B} = \frac{\mu_0 I}{4\pi} \cdot \frac{d\overrightarrow{l} \times \overrightarrow{r}}{r}$

D. $d\overrightarrow{B} = \frac{\mu_0 I}{4\pi} \cdot \frac{d\overrightarrow{l} \times \hat{r}}{r}$

Answer:

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6. If we double the radius of a current carrying coil keeping the current unchanged, the magnetic field at its centre will

A. remain unchanged

B. become double

C. be halved

D. become four times

Answer:

Watch Video Solution

7. A circular coil of radius r carries a current I . It produces magnetic fields B_1 at the centre of the coil and B_2 at an axial point at a distance r from the centre. The ratio of B_1 and B_2 is

A. $\sqrt{2} : 1$

B. $2 : 1$

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

D. $4 : 1$

Answer:

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8. In the given figure a conductor is carrying a current I. The magnitude of magnetic field at the origin is

A. $-\frac{\mu_0 I}{4r}\left(\frac{1}{\pi}\hat{i}+\frac{1}{2}\hat{k}\right)$

B. $\frac{\mu_0 I}{4\pi}\left(\frac{1}{\pi}\hat{i}-\frac{1}{2}\hat{j}\right)$

C. $\frac{\mu_0 I}{4r}\left(\frac{1}{\pi}\hat{i}-\frac{I}{R}\hat{j}\right)\frac{\mu_0}{4r}$

D. $\frac{\mu_0 I}{4r}\left(\frac{2}{\pi}\hat{i}+\hat{j}\right)$

Answer:

View Text Solution

9. Ratio of magnetic fields at the centre of a current carrying coil of radius r and at a distance 3r on its axis is

A. $\sqrt{10}$

B. $2\sqrt{10}$

C. $10\sqrt{10}$

D. $20\sqrt{10}$

Answer:

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10. Two wires PQ and QR carry equal currents I. One end of each wire extends to infinity and $\angle PQR = \theta$. The magnitude of the magnetic field at O on the bisector of angle $\angle PQR$ at a distance r from point Q is

A. $\frac{\mu_0}{4\pi} \cdot \frac{I}{r} \sin\frac{\theta}{2}$

B. $\frac{\mu_0}{4\pi} \cdot \frac{I}{r} \cot\left(\frac{\theta}{2}\right)$

C. $\frac{\mu_0}{4\pi} \cdot \frac{I}{r} \tan\frac{\theta}{2}$

D. $\frac{\mu_0}{2\pi} \cdot \frac{I}{r} t\left(\frac{1+\cos\frac{\theta}{2}}{\sin\frac{\theta}{2}}\right)$

Answer:

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11. A vertical straight conductor carries a current vertically upwards. A point P lies to the east of it at a small distance and another point Q lies to the west at the same distance. The strength of magnetic field at P is

A. greater then that at Q

B. same as that at Q

C. less then that at Q

D. greater or less depends on the strength of current

Answer:

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12. Magnitude of magnetic field at the point P in arrangement shown in the figure will be

A. $\frac{\mu_0 i}{\sqrt{2}\pi d}\left(1-\frac{1}{\sqrt{2}}\right)$

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

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

D. $\frac{\mu_0 i}{\sqrt{2}\pi d}\left(1+\frac{1}{\sqrt{2}}\right)$

Answer:

View Text Solution

13. The magnetic field at the point of intersection of diagonals of a square wire loop of side L carrying a current I is

A. $\frac{\mu_0 I}{\pi L}$

B. $\frac{2\mu_0 I}{\pi L}$

C. $\frac{\sqrt{2}\mu_0 I}{\pi L}$

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

Answer:

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14. A circular coil of radius R carries an electric current i. The magnetic field at a point on the axis at a distance x from the centre of the coil $(x > > R)$ varies as

A. $\frac{1}{x}$

B. $\frac{1}{x^{3/2}}$

C. $\frac{1}{x^2}$

D. $\frac{1}{x^3}$

Answer:

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15. The magnetic field B within a solenoid of length L with N turns and carrying a current I is given by

A. $\frac{\mu_0 N i}{e L}$

B. $\mu_0 N i$

C. $\frac{\mu_0 N i}{L}$

D. $\frac{4\pi \mu_0 N i}{L}$

Answer:

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

A. radius of the solenoid

B. number of turns per unit length

C. current flowing through it

D. medium in which the solenoid is placed

Answer:

Watch Video Solution

17. A charged particle enters a magnetic field $\vec{B}$ perpendicularly with velocity v and keeps rotating along a circular path of radius r. What will happen if the magnitude of $\vec{B}$ is increased?

A. v will increase

B. v will decrease

C. r will increase

D. r will decrease

Answer:

Watch Video Solution

18. The radius of the circular path described by a charged particle in a magnetic field is directly proportional to the

A. momentum of the particle

B. kinetic energy of the particle

C. amount of charge the particle

D. strength of the magnetic field

Answer:

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19. The magnitude of an electric field along x-axis is $1V.m^{-1}$ and in the same region the magnitude of a magnetic field along y-axis is 10^{-6}T . What should be the velocity of an electron in that region so that it will continue to move with uniform velocity along z-axis without suffering any deviation?

A. $10^6 m. s^{-1}$

B. $10^{-6} m. s^{-1}$

C. $2 \times 10^6 m. s^{-1}$

D. $2 \times 10^{-6} m. s^{-1}$

Answer:

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20. A beam of protons projected along positive x-axis experiences a force, due to a magnetic field along, the negative y-axis. Then the magnetic field must be

A. along the z-axis

B. along the negative z-axis

C. on the xy-plane

D. on the xz-plane

Answer:

Watch Video Solution

21. A moving electron and a moving proton enter a uniform magnetic field in a direction perpendicular to that of the field. If the radii of their circular orbits are equal, they have the same

A. velocity

B. momentum

C. kinetic energy

D. charge to mass ratio

Answer:

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22. An α- particle and a proton having the same momentum enter a region of uniform magnetic field and move in circular paths. The ratio of the radii of curvature of their circular paths r_a / r_p in the field is

A. 1

B. $1/4$

C. $1/2$

D. 4

Answer:

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

A. The electron will turn towards right

B. the speed of the electron will decrease

C. the speed of the electron will increase

D. the electron will turn towards left

Answer:

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24. A particle of charge q moves with a velocity $\overrightarrow{v} = a\hat{i} + b\hat{j}$ in magnetic field $\overrightarrow{B} = c\hat{i} + d\hat{j}$.

The force acting on the particle has magnitude F. Them

A. F=0 if ad=bc

B. F=0 if ad =-bc

C. F=0 if ac=-bd

D. $F \propto (a^2 + b^2)^{1/2} \times (c^2 + d^2)^{1/2}$

Answer:

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25. A proton, a deuteron and an α- particle are accelerated by the same potential and then enter a uniform magnetic field perpendicularly. The ratio of radii of their circular paths will be

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

B. $2:2:1$

C. $1:2:1$

D. $1:1:1$

Answer:

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26. Through a straight conduction wire, current is flowing along positive z-direction. What should be the direction of the applied magnetic field so that the wire will experience the maximum force?

A. along positive or negative z-axis

B. along any direction on xz-plane

C. along any direction on xy-plane

D. along any direction on yz-plane

Answer:

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

A. Bir

B. $2\pi rIB$

C. 0

D. $\pi r I B$

Answer:

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28. A magnetic field is applied along positive z-axis. How should a plane conducting loop be placed in this field so that loop will not experience any torque ?

A. on xy-plane

B. on xz-plane

C. on yz-plane

D. along z-axis

Answer:

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29. The path of a charged particle whose motion is perpendicular to a uniform magnetic field is

A. a straight line

B. an ellipse

C. a circle

D. a helix

Answer:

Watch Video Solution

30. Two concentric coils each of radius 2π cm are placed at right angles to each other. 3A and 4 A are the currents flowing in the coils.

The magnetic induction in weber/m^2 at the centre of the coils will be $\left(\mu_0 = 4\pi \times 10^{-7} H.m^{-1}\right)$

A. 5×10^{-5}

B. 7×10^{-5}

C. 12×10^{-5}

D. 10^{-5}

Answer:

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31. For 1 A current, a galvanometer shows its full-scale deflection. If a resistance of 800Ω is series, it is converted into a voltumeter of range 0-1000 V. What is the resistance of the galvanometer?

A. 50Ω

B. 100Ω

C. 200Ω

D. 800Ω

Answer:

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32. In an ammeter, 0.5% of main current passes through the galvanometer. If the resistance of galvanometer is G, the resistance of ammeter will be

A. $\frac{G}{200}$

B. $\frac{G}{199}$

C. 200 G

D. 199 G

Answer:

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33. What is the nature of lines of force in a uniform magnetic field?

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34. In a uniform magnetic field, lines of force are equispaced ______ straight lines. [Fill in the blank]

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35. How is the direction of a magnetic field $\vec{B}$ at a point related to the magnetic line of force passing throught that point?

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36. A manetic needle is kept below a very long conducting wire. If current is sent through the wire from north to south, in which direction will the north pole of the needle be deflected?

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37. A magnetic needle is placed below a very long conducting wire. If current is sent through the wire from east to west, in which direction will the north pole of the needle be deflected?

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38. How does the magnetic field at a point near a long straight current-carrying conductor vary with the current and the distance of the point ?

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39. When 1 A current flows through a circular conductor, the magnetic field generated at its centrs is 10^{-7} T. For what value of the current, will the magnetic field be 10^{-6} T?

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40. Which physical quantity has the unit $Wb. m^{-2}$? Is it a scalar or a vector quantity?

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41. What is the unit of magnetic permeability μ_0 of vacuum?

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42. What is the magnetic field produced at a distance 1 m from a long, straight conductor carrying 1 A current?

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43. The magnetic field at a distance 1 m from a long straight conductor is $10^{-7}T$. What is the current through the conductor?

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44. A solenoid carrying 1 A current has a length of 1 m and contains 10000 turns. What is the magnetic field on the axis of the solenoid ?

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45. What will be the nature of the path of a charged particle when it enters a uniform magnetic field $\vec{B}$ normally?

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46. If the magnetic force on a moving charged particle in a magnetic field becoms ______ the direction of motion of the particle, or its opposite direction, indicates the direction of magnetic field. [Fill in the blank

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47. If the angle between the direction of motion of a charged particle and the direction of a magnetic field $\overrightarrow{B}$ is ____ then the magnetic force acting on the charged particle will be maximum. [Fill in the blank]

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48. An electron moving at right angle with a uniform magnetic field revolves along a cirular path. To reduce the radius of that circular path to half, the magnetic field should be _____ [Fill in the blank]

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49. An electron and a proton enter a uniform magnetic field perpendicularly with the same speed. How many times larger will be the radius of the proton's path than that of the electron's path? Given: proton is 1840 times heavier then the electron.

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50. Can a stationary charge produce a magnetic field?

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51. What is the magnitude of force experienced by stationary charge placed in a uniform magnetic field?

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52. Does any force act on a magnetic north pole if it is brought near a negatively charged conductor at rest?

Watch Video Solution

53. Does any force act on a moving charge in a magnetic field?

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54. A long straight wire is carrying a current. An electron starts its motion on a line parallel to the wire in a direction same as that of the current. What will be the direction of the force on the electron?

Watch Video Solution

55. A charge q moves with velocity $\overrightarrow{v}$ at an angle θ to a magnetic field $\overrightarrow{B}$. What is the force experienced by the particle?

Watch Video Solution

56. An electron moving with a veloctiy of $10^7 m. s^{-1}$ enters a uniform magnetic field of 1 T along a direction parallel to the field. What would be its trajectory?

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57. A certain proton moving through a magnetic field region experience maximum force. When does this occur?

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58. An electron beam projected along positive x-axis experiences a force, due to a magnetic field along positive y-axis. What is the direction of the magnetic field?

Watch Video Solution

59. If a straight current carrying conductor remains ______ to the direction of a magnetic field, the magnetic force acting on the conductor will be zero. [Fill in the blank]

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60. If the plane of a current carrying conducting loop be ______ to a magnetic field the torque acting on the loop becomes zero. [Fill in the blank]

Watch Video Solution

61. What is the mutual action between two unlike parallel currents?

Watch Video Solution

62. Two long and straight parallel wires are carrying current 1 A each. If the distance between the two wires be 1 m, what will be force acting per unit length on them?

Watch Video Solution

63. What type of galvanometer is used to prepare an ammeter or a voltmeter in the laboratory?

Watch Video Solution

64. In case of a moving coil galvanometer, what is the relation between the current I and the angle of deflection θ?

Watch Video Solution

65. How is a galvanometer converted into an ammeter?

Watch Video Solution

66. How should a resistance be connected with a galvanometer to convert it into a voltmeter?

Watch Video Solution

67. What is the nature of magnetic field in a moving coil galvanometer?

Watch Video Solution

Short Answer Type Questions I

1. Draw a diagram of the magnetic lines of force to show that a current carrying solenoid is equivalent to a bar magnet.

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2. What will happen if a current carrying solenoid is suspended horizontally with a thread?

Watch Video Solution

3. Why is phosphor-bronze used as the material of the suspension-thread in a suspended coil galvanometer?

Watch Video Solution

4. Show that, if the range of an ammeter is increased n times, its resistance becomes $\frac{1}{n}$ times its previous value.

Watch Video Solution

5. The distance between two long and parallel wires is b. If the current flowing through each of them is iA, what will be the force acting per unit length of each wire?

Watch Video Solution

6. Explain why the resistance of an ammeter is usually made small but that of a voltmeter is made large.

Watch Video Solution

7. On any plane perpendicular to a long straight current carrying conductor, the magnetic lines of force are circular. Discuss whether these circular lines of force are equidistant.

Watch Video Solution

8. A long straight current carrying conductor is kept along the axis of circular coil carrying same current. What will be the mutual force between them?

Watch Video Solution

9. A moving charged particle is not deflected when it passes through a region. Can it be said that no magnetic field exists in that region?

Watch Video Solution

10. Equal currents passing through two infinitely long parallel wires. Would there be any magnetic field midway between the wires, if the currents are (i) in the same direction, (ii) in opposite directions?

Watch Video Solution

11. Sketch a graph to show the variation of the magnetic field due to a circular current carrying coil with distance along its axis on both sides of its centre.

Watch Video Solution

12. A charged particle released from rest in a region of steady and uniform electric and magnetic fields, which are parallel to each other. What will be the nature of the path followed by the charged particle?

Watch Video Solution

13. An electron moving with velocity $\overrightarrow{v}$ along positive x-axis enters a uniform magnetic field $\overrightarrow{B}$ direction along positive y-axis. What is the magnitude and direction of force on the electron?

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

Watch Video Solution

15. Two protons P and Q moving with the same speed enter magnetic field B_1 and B_2 respectively at right angles to the field directions. If B_2 is greater than B_1 for which of the protons P and Q the circular path in the magnetic field will have a smaller radius?

Watch Video Solution

16. How will the magnetic field internsity at the centre of 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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17. Which one of the two an ammeter and a milliammeter, has a higher resistance and why?

Watch Video Solution

Short Answer Type Questions Ii

1. What will be the nature of the force acting on a current carrying conductor due to current through another parallel conductor?

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2. A charge 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.

Watch Video Solution

3. Through each of two long straight parallel conducting wires kept 4 cm apart, 10 A current is flowing. If the direction of current in the wires are mutually opposite, what will be the magnitude of magnetic field produced at a point just midway between the two wires?

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Problem Set I

1. A long wire PQR is bent at right angles at the point Q [Fig.1.107] and 2 A current is flowing through it. Determine the magnetic field at the point O on the extension of RQ, when OQ =5 cm.

View Text Solution

2. The current through a very long wire PQRST is I=10A [Fig.1.108]. Determine the magnetic field at the centre O of the semi-circular part QRS, when OQ=2 cm.

View Text Solution

3. The radius of the first electron orbit of a hydrogen atom is $0.5\mathring{A}$. The electron moves in this orbit with a uniform speed of

$2.2 \times 10^6 m. s^{-1}$. What is the magnetic field produced at the centre of the nucleus due to the motion of this electron?

Watch Video Solution

4. The length of long straight solenoid is 10 cm and the number of turns in it is 200. If 1 A current flows through it, determine the magnetic field at any on the aixs of the solenoid.

Watch Video Solution

5. The radius of toroid is 0.2 m and the number of turns in it is 1000. If 100 mA current passes through the toroid, determine the magnetic field at any point on its axis.

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6. A 0.5 m long solenoid has 500 turns and has a flux density of $2.52 \times 10^{-3} T$ at its centre. Find the current in the solenoid.

Watch Video Solution

7. An electric field and a mangetic field act at right angles to each other in a region. The electric field is $E = 10^5 V . m^{-1}$ and the magnetic field is B=0.4T. What should be the velcoity of projection of a charge q in a direction perpendicular to both the fields so that it will not be deflected?

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8. If a deuteron enters a magnetic field of 1 $Wb. m^{-2}$ at right angles to it, what should be the time period of its revolution?

[masss of the deuteron $= 3.3 \times 10^{-27} kg$ and charge = $1.6 \times 10^{-19} C$

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9. An electron enters a magentic field of 3T at an angle of 30° with a velocity of $10^6 m. s^{-1}$.

What force will act on the electron?

$e = 1.6 \times 10^{-19} C$

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10. Calculate the force acting on an electron moving with a velocity $\left(3\hat{i} + 3\hat{j}\right)m.s^{-1}$ in a magnetic field of strength $\left(2\hat{j} + 3\hat{k}\right)$ tesla.

Watch Video Solution

11. An electron (mass $= 9.1 \times 10^{-31} kg$, charge $= -1.6 \times 10^{-19} C$) completes one revolution in 10^{-8}s in its circular orbit on a plane perpendicular to a uniform magnetic field. Determine the magnetic field.

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12. A proton and an alpha particle having the same kinetic energy are allowed to pass through a uniform magnetic field perpendicular to their direction of motion. Compare the radii of the paths of proton and alpha particle.

Watch Video Solution

13. An α -particle and a proton are accelerated from rest thruogh the same potential difference and both enter a uniform perpendicular magnetic field. Find the ratio of their radii of curvature.

Watch Video Solution

14. Through a straight conduction wire of length 1 m 2, A current is flowing. If the wire is placed normal to a uniform magnetic field of strength $10^{-3}T$, what will be the magnetic force acting on the wire

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15. The radius of a circular coil of 100 turns in 5 cm and it carries a current of 10 A. What torque will act on the coil when its plane is kept at 30° with a uniform magnetic field of 0.01 T?

Watch Video Solution

16. Two long straight parallel conducting wires, carrying equal currents, are kept 8 mm apart. To produce a force of $0.01N.\,m^{-1}$, what should be the current?

Watch Video Solution

17. Two long parallel straight wires X and Y, separated by a distance of 2.5 cm in air, carry currents of 5 A and 2.5 A respectively in opposite directions. Calculate the magnitude and direction of the force on a 10 cm length of the wire Y.

Watch Video Solution

18. The resistance of a galvanometer is 10Ω and it shows fullscale deflection for 1 mA current. What is the resistance of the shunt to be used to convert this instrument into an ammeter ot read current up to 10 A?

Watch Video Solution

19. The resistance of a moving coil galvanometer is 99Ω and the current for its full scale deflection is $100\mu A$. To convert the galvanometer into an ammeter to read a maximum current of 10 mA, what should be

the resistance to be connected in parallel with it?

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20. The resistance of a moving coil galvanometer is 500Ω and the current required for its maximum deflection is $10\mu A$. To convert the galvanometer into a voltmeter to read a maximum voltage of 100 mV, what should be the resistance to be connected in series with it?

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21. A milliammeter with full scale deflection at $100\mu A$ has a resistance of 750Ω. Find the resistance necessary to use the instrument as a voltmeter to read 0-50 volts.

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22. A galvanometer of resistance 200Ω can withstand a maximum current of 1 mA. What is the resistance of shunt that should be

connected in parallel to get an ammeter of range 0-1 A?

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23. A galvanometer of resistance 500Ω can withstand a maximum current of $100\mu A$. A shunt of resistance 1Ω is connected in parallel to it. How would the resulting device perform?

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24. A galvanometer of resistance 150Ω shows full scale deflection for a current of 20 mA. What is the resistance that should be connected in series with it to get a voltmeter of range 0-30 V?

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25. The terminal potential difference of galvanometter is 1 V for its full-scale deflection. A resistance of 950Ω, connected in series with it, converts it to a voltmeter that can read a maximum of 20 V. What is the resistance of the galvanometer?

Watch Video Solution

Problem Set Ii

1. A circular coil of radius 5 cm and of 100 turns is made of an insulated copper wire of diameter 0.4 mm. If current is sent through it by connecting its two ends with a battery of emf 2 V, what will be the magnetic field produced at its centre? Resistivity of cooper $= 1.76 \times 10^{-8} \Omega m$

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2. A circular coil of 100 turns and of radius 4 cm carries a current of 0.5 A. Find out the magnetic field at the centre of this coil. What will be the percentage fall of this magnetic field at a point on the axis, 3 cm away from the centre?

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

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4. Two insulated infinitely long wires are lying mutually perpendicular to each other as shown in the figure. If the two wires carry currents I_1 and I_2 then find the magnetic field at the point P(a,b).

View Text Solution

5. A current I flows in the network shown in the figure. Find the magnetic field at the point

P.

View Text Solution

6. A rectangular loop of metallic wire of length a and breadth b carries a currnet I. Find the magnitude of the magnetic field at the centre of the loop.

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7. A linear solenoid is made of a copper wire of diameter 0.4 mm. Its length is 10 cm, diameter 1 cm and number of turns 1000. If the two ends of the solenoid is connected to a battery of emf 2 V, determine the magnetic field produced at the mid-point on the axis of the solenoid. Resistivity of copper $1.76 \times 10^{-8} \Omega m$

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8. A solenoid having 60 turns per cm is made of copper wire of radius 0.3 mm. The solenoid is 20 cm long and its diameter is 1 cm . If the two ends of the solenoid is connected to a battery of 5 V, determine the magnetic field produced at any point on the axis of the solenoid. Given, resistivity of copper $= 1.76 \times 10^{-8} \Omega . m$

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9. If an electron is moving with a velocity of $10^{-7} m . s^{-1}$ at right angles to a magnetic field of strength $10^{-3} T$, determine the magnetic force acting on the electron and the radius of the circular path it describes. Given, mass of an electron $= 9.1 \times 10^{-31} kg$, electronic charge $= 1.6 \times 10^{-19} C$.

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10. An electron (charge $= -1.6 \times 10^{-19}C$, mass $= 9.1 \times 10^{-31}kg$) enters a uniform electric field of magnitude $10V.m^{-1}$ with velocity $10^6 m.s^{-1}$ normally to the direction of the field. If it covers 10 cm path inside that electric field, determine the displacement of the electron normal to the direction of its initial velocity.

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11. In a region, a uniform electric field of $100V.\,m^{-1}$ is acting along x-axis and a uniform magnetic field of $10^{-4}T$ along y-axis. If an electron enters that region along z-axis with a velocity of $10^5 m.\,s^{-1}$, determine the magnitude and direction of the force acting on it. Charge of an electron $= 1.6 \times 10^{-19} C$.

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12. An electron revolves along a circular path on a plane perpendicular to a uniform magnetic field of 0.001 T with a velocity of $10^6 m.\ s^{-1}$. (i) What is the force acting on the electron? (ii) What is the radius of its circular path? (iii) For each complete revolution of the electron what will be the increase of its energy? Given, charge of an electron $= -1.6 \times 10^{-1} C$ mass $= 9.1 \times 10^{-31} kg.$

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13. A proton beam is being accelerated by a cyclotron. Each of the dees has a radius of 1.2 m, and a magnetic field of $0.2Wb.\,m^{-2}$ is applied normal to them. What is

the frequency of the alternating emf applied across the dees,

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14. A proton beam is being accelerated by a cyclotron. Each of the dees has a radius of 1.2 m, and a magnetic field of $0.2Wb.\,m^{-2}$ is applied normal to them. What is the energy attained, in million eV, by each proton? Given, charge of proton $= 1.6 \times 10^{-19} C$, its mass $= 1.67 \times 10^{-27} kg$, $1eV = 1.6 \times 10^{-19} J$

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15. An electron travels in a circular path of radius 20 cm in a magnetic field of $2 \times 10^{-3} T$. Calculate the speed of the electron. What is the potential difference through which the

electron must be accelerated to acquire this speed?

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16. A rectangular coil of length 20 cm, breadth 5 cm and number of turns 50 is suspended from the mid-point of its breadth and is inclined at an angle of 60° with the lines of force of uniform magnetic field of 0.05 T. If 5 A current flows in the coil, what will be the torque acting on it?

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17. A rectangular coil of sides 12 cm and 8 cm having 1000 turns and carrying a current of 250 mA is placed in a uniform magnetic field of 0.25 tesla directed along positive x-axis. (i) What is the maximum torque the coil can expereince and in which direction? (ii) For which orientation of the coil is the torque zero?

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18. A rectangular loop of sides 0.25 m and 0.10m is carrying a current of 15 A with its longer side parallel to a long straight conductor 0.02 m apart carrying a current of 25 A. What is the force on the loop?

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19. The resistance of galvanometer is 10Ω. If gives a full scale deflection for a current of 15 mA. How can it be converted into

a voltmeter to read up to 1.5 V and

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20. The resistance of galvanometer is 10Ω. If gives a full scale deflection for a current of 15 mA. How can it be converted into

an ammeter to real up to 5 A?

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Hots Numerical Problems

1. The radii of two circular coils are 5 cm and 10 cm and their number of turns are 40 and 100, respectively. The coils are coplanar and concentric and a 4 A current is sent through the first coil. Find the current and its direction through the second coil so that the magnetic field at thier centre becomes zero?

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2. The radius of each of two circular coils of single turn is r. The two coils are placed parallel to each other with a common axis. The distance between their centres is $\frac{r}{2}$. If equal current is sent through the two coils in the same direction, what will be the magnetic field (i) at the centre of each coil and (ii) at the mid point on the line joining the centres of the coils? What is the ratio of these two magnetic fields?

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3. Two circular coil A and B subtend the same solid angle at point P lying on the axis of the coils. Smaller coil B is midway between A and P. If both coils. Carry the same current in the same senes then find the ratio of the magnetic field of A at $P(B_A)$ to magnetic field of B at $P(B_B)$.

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4. Each side of a hexagonal loop of a metal wire is a. The loop carries a current I. Find the magnitude of the magnetic field at the centre of the loop

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5. Two identical equilateral triangles, insulated from each other, form a star. Length of each side of each triangle is L. A current I flows along one of the triangles in clockwies direction and along the other triangle in anti-clockwise direction. Calculate the magnetic field at the centroid of those two triangles.

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6. A metallic wire carrying a current I is bent into a form as in the figure. The circular portion MNO of the wire is of radius r and the straight portion MO subtends an angle 2θ at the centre C. Find the magnetic field at C due to the whole conductor.

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7. Four equal arcs of radius R and four equal arcs of radius 2R form a loop as shown in the figure. It is carrying a current I. If the arcs subtend equal angles at the common centre then calculate the magnetic field at the centre of the loop.

View Text Solution

8. Current I flows in a coductor in the direction ABCDEFO, as shown in the figure. Find the expression for the magnetic field at the centre O.

View Text Solution

9. A closely wound solenoid of 1000 turns and area of cross section $2 \times 10^{-4} m^2$ carries a

current of 2A. If is placed with its horizontal axis at 30° with the direction of a uniform horizontal magnetic field of 0.16 T.

What is the torque experienced by the solenoid?

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10. A closely wound solenoid of 1000 turns and area of cross section $2 \times 10^{-4} m^{2}$ carries a current of 2A. If is placed with its horizontal axis at 30° with the direction of a uniform horizontal magnetic field of 0.16 T.

What is the amount of work done to rotate the solenoid from stable orientation to unstable orientation?

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11. An electron (charge $= -1.6 \times 10^{-19} C$, mass $= 9.1 \times 10^{-31} kg$) enters a magnetic field of strength 0.001 T with a velocity of $10^5 m.\, s^{-1}$ at an angle 60° with the direction of the field. What will be the time period and pitch of the electron in that magnetic field?

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12. A solenoid of length 0.4 m and of 500 turns carries 3 A current. A thin coil of 10 turns and of radius 0.01 m carries 0.4 A current. Calculate the torque required to hold the coil in the middle of the solenoid with its axis parallel to the axis of the solenoied. $\left[\mu_0 = 4\pi \times 10^{-7} H.m^{-1}\right]$

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13. A proton obliquely enters a uniform magnetic field of 0.5 T. It the component of its velocity along and perpendicular to the direction of the magnetic field are $1.5 \times 10^5 m. s^{-1}$ and $2 \times 10^5 m. s^{-1}$, respectively, calculate the radius of the helical path followed by the proton ant its pitch. $[m = 1.67 \times 10^{-27} kg, e = 1.6 \times 10^{-19} C]$

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14. In Fig. 1.115, the galvanometer G has a resistance of 100Ω and it shows full scale deflection for a current of 5 mA.

(i) The device between A and B acts as a voltmeter of range 0-20 V when the key k is open, and

(ii) the device between A and C acts as an ammeter of range 0-1 A when the key k is closed. Find out the resistances of R_1 and R_2

.

1. Statement I : A magnetic needle which can rotate in a horizontal plane undergoes a deflection when current is passed through a conducting wire, placed above and parallel to it.

Statement II : A magnetic field is developed around a current carrying conductor.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

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2. Statement I : A long straight conductor attracts iron filings when a current is passed through it.

Statement II : A magnetic field is developed around a current carrying conductor.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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3. Statement : I Neither the magnetic field vector $\overrightarrow{B}$ nor the magnetic intensity vector $\overrightarrow{H}$ of a magnetic field depend on the nature of the medium.

Statement : II If the magnetic permeability of a medium is μ then $\overrightarrow{H} = \frac{1}{\mu}\overrightarrow{B}$

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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4. Statement : I A galvanometer of resistance G is converted to an ammeter by increasing its range n times. The resistance of the ammeter is $\frac{G}{n}$.

Statement : II A shunt of resistance $\frac{G}{n-1}$ has to be connected in parallel with a galvanometer in order to increase its range n times.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

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5. Statement : I The velocity of ejection of a charged particle, being accelerated in a cyclotron remains constant irrespective of the applied magnetic field.

Statement : II In a cyclotron the charged particle is accelerated only due to the applied electric field because magnetic force is a no-work force.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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6. Statement : I If an electron and a proton are projected with equal momentum in a uniform transverse magnetic field, then the curvature of their paths is equal.

Statement II : Mass of proton is much higher than that of electron.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: B

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7. Statement : I A charged particle moves perpendicular to a magnetic field. Its kinetic energy remains constant, but momentum changes.

Statement II : A magnetic force acts on the charged particle.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: B

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Multiple Correct Answers Type

1. A magnetic needle facing north-south can roatate freely in a horizontal plane. A conducting wire is placed parallel to it along north-south direction.

A. Direction of current is from south to north and the conductor is above the magnet-north pole of the magnet will be deflected towards west.

B. Direction of current is from north to south, the conductor is above the magnet-south pole of the magnet will be deflected towards west.

C. Direction of current is from south to north, the conductor is below the magnet-south pole of the magnet will be deflected towards west.

D. Direction of currnet is from north to south, the conductor is below the magnet-the north pole of the magnet will be deflected towards west.

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

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2. The magnetic field developed at a point near a straight current carrying conductor depends on

A. material of the conductor

B. distance of point from the conductor

C. direction and magnitude of current

D. medium between the point and conductor

Answer: B::C::D

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3. Two identical charged particles enter a uniform magnetic field with the same speed but at angles 30° and 60° with the field. Let a, b and c be the ratios of their time periods, radii and pitches of the helical paths. Then

A. abc=1

B. $abc > 1$

C. $abc < 1$

D. a=bc

Answer: A::D

Watch Video Solution

4. In case of a current carrying solenoid

A. internal lines of force are parallel

B. the lines of force become congested on increasing the current

C. no north-south pole is produced in absence of a core of magnetic material

D. the magnetic field increases on increases on increasing the number of turns

Answer: A::B::D

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5. A particle with charge q is moving with a velocity $\overrightarrow{v}$ in a magnetic field $\overrightarrow{B}$. If the force acting on the particle is $\overrightarrow{F}$ then,

A. $\overrightarrow{F} = 0$, when $\overrightarrow{v}$ and $\overrightarrow{B}$ are parallel

B. magnitude of $\overrightarrow{F}$ is maximum when $\overrightarrow{v}$ and $\overrightarrow{B}$ are perpendicular to each other

C. $\left|\overrightarrow{F}\right| = \frac{1}{2} qvB$ when the angle between $\overrightarrow{v}$ and $\overrightarrow{B}$ is 45°

D. direction of $\overrightarrow{F}$ remains the same when the directions of both $\overrightarrow{v}$ and $\overrightarrow{B}$ are reversed simultaneously

Answer: A::B::D

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6. Rotation of Barlow's wheel is due to action of magnetic field on current. In case of this wheel

A. the rotational speed does not increase if both the current and the magnetic field are increased simultaneously

B. the rotational speed increases when the current is increased

C. the rotational speed increases when the magnetic field is increased

D. the rotational speed becomes higher as the wheel is mode lighter

Answer: B::C::D

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7. Two long straight conducting wires ara kept parallel to each other at a distance r apart. When a current I passes through both the wires in the same direction, a force of attraction $\overrightarrow{F}$ acts between the wires. Which of the following statement is/are true?

A. when r =0.5 m and $I = 1A$, $F = 10^{-7}N$

B. when r=2.0 m and $I = 1A$, $F = 10^{-7}N$

C. when r =8.0 m and $I = 2A$, $F = 10^{-7}N$

D. when r = 1.0 m and

$$I = 1A, F = 2 \times 10^{-7} N$$

Answer: A::B::D

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Integer Answer Tpye

1. Magnetic field developed at the centre of current-carrying circular coil of diameter 6 cm is B_0 and the magnetic field at distance $3\sqrt{3}$

cm away from the centre and on the axis is B_1.

What is the ratio $B_0 : B_1$?

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2. 10 A current is passing through each of two long straight parallel wires. What should be the distance between the two wires (in cm) so that 0.4 dyn force acts per cm length of each wire? $\left[\mu_0 = 4\pi \times 10^{-7} H.m^{-1}\right]$

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3. Two particles of equal charge are accelerated by a potential difference and they enter a uniform magnetic field perpendicularly. The particles started rotating in circular orbits of radii 10 cm and 5 cm. What is the ratio of their masses?

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4. The radius of each of two mutually perpendicular concentric coils is 2π cm. Magnetic induction at the centre of the coils is

$10^{-4} Wb. A^{-1}$. If the current in the first coil be 8 A then what is the value of cuurent (in A) in the second coil? $\left[\mu_0 = 4\pi \times 10^{-7} Wb. A^{-1}. m^{-1}\right]$

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5. The number of turns in a long solenoid is $250 cm^{-1}$ .What current (in A) should pass through it so that the axis magnetic field will be $0.02\pi Wb. m^{-2}$ $\left[\mu_0 = 4\pi \times 10^{-7} H. m^{-1}\right]$

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6. The frequency of a cyclotron is 10 MHz. The kinetic energy acquired by a proton by this cyclotron is 20.6 MeV. What is the radius (in m) of the two dees of the cyclotron? Mass of proton $= 1.67 \times 10^{-27} kg.$

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7. A galvanometer of resistance 36Ω can measure current up to 1 A. What shunt (in Ω)

should be connected to the galvanometer so as to increase its range to 10 A?

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Examination Archive

1. Does a stationary charge experience any force in a magnetic field ?

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2. Write down the mathematical form of Ampere's circuital law related to magnetic field produced by electric current and state the meaning of the symbols used.

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3. Use Ampere's law to determine the intensity of magnetic field at a point on the axis of a toriod.

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4. A electron is moving with a velocity $\vec{v} = (\hat{i} + 2\hat{j})m.s^{-1}$ in the magnetic field $\vec{B} = (2\hat{i} + 2\hat{j})Wb.m^{-2}$. Determine the magnitude and direction of the force acting on the electron. Charge of an electron is $-1.6 \times 10^{-19} C$.

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5. The number of turns of the coil of a moving coil galvanometer is n, the area enclosed by

the coil is A and the magnetic field is B. Find how much torque will act on the coil if a current of strength I flows through that coil.

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6. If the torsional rigidity per unit angle of twist of the suspension of the coil is k, find out an expression for the current sensitivity of galvanometer.

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7. Draw a circuit diagram to show how to convert a galvanometer into a voltemeter.

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8. Which physical quantity has the unit $Wb. m^{-2}$? Is it a scalar or a vector quantity?

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9. Write down the equation of Lorentz force acting on a moving charged particle.

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10. (i) α-particle and (ii) β-particle are both projected with the same velocity v perpendicularly to the magnetic field B. Which particle will experience greater force?

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11. How is a galvanometer converted into a voltmeter?

Watch Video Solution

12. The plane of a suspended current carrying rectangular coil makes an angle θ with the direction of uniform magnetic field. Calculate the torque acting on the coil.

Watch Video Solution

13. State Ampere's circuital law. Using this law obtain an expression for the intensity of the magnetic field on the axis of a toroidal solenoid for a current of I ampere.

Watch Video Solution

14. In a compact coil of 50 turns, the current strength is 10 A and the radius of the coil is $25 \times 10^{-2} m$. Find the magnitude of the magnetic field at its centre.

Watch Video Solution

15. With an accompanying diagram, wirte down Biot-Savart's law in vector form. Can a cyclotron accelerate neutrons?

Watch Video Solution

16. What is cyclotron frequency? It is possible for a cyclotron to accelerate neutrons?

Watch Video Solution

17. Write down the mathematical form of Ampere's circuital law related to magnetic field produced by electric current.

Watch Video Solution

18. A proton with a speed of $2 \times 10^{7} m. s^{-1}$ enters a magnetic field of flux density $1.5 Wb. m^{-2}$, making an angle of 30° with the field. The force acting on the proton is

A. $2.4 \times 10^{-14} N$

B. $0.24 \times 10^{-12} N$

C. $0.024 \times 10^{-24} N$

D. $24 \times 10^{-12} N$

Answer:

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19. A straight conductor of length l m carrying a current I A is bent in the form of a semicirle. The magnetic field (in tesla) at the centre of the semicircle is

A. $\frac{\pi^2 I}{l} \times 10^{-7}$

B. $\frac{\pi I}{l} \times 10^{-7}$

C. $\frac{\pi I}{l^2} \times 10^{-7}$

D. $\frac{\pi I^2}{l} \times 10^{-7}$

Answer:

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20. Find out the expression for the magnetic field at a point on the axis of a toroid of N turns having average radius r and carrying a current I. Show that the magnetic field in the open space inside and outside the toroid is zero.

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Examination Archive Wbjee

1. Two long parallel straight wires P and Q separated by a distance 5cm in air carry currents of 4A and 2A respectively in same direction. Find the magnitude of the force acting per cm of the wire P and indicate the direction of the force.

Watch Video Solution

2. A galvanometer having internal resistance 10Ω requires 0.01 A for a full-scale deflection. To convert this galvanometer to a voltmeter of full-scale deflection at 120 V, we need to connect a resistance of

A. 11990Ω in series

B. $11990 Oemga$ in parallel

C. 12010Ω in series

D. 12010Ω in parallel

Answer:

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3. A long conducting wire carrying a current I is bent at 120° [Fig. 1.128]. The magnetic field B at a point on the right bisector of bending angle at a distance d from the bend is (μ_0 is the permeability of free space)

A. $\frac{3\mu_0 I}{2\pi d}$

B. $\frac{\mu_0 I}{2\pi d}$

C. $\frac{\mu_0 I}{\sqrt{3}\pi d}$

D. $\frac{\sqrt{3}\mu_0 I}{2\pi d}$

Answer:

Watch Video Solution

4. A proton of mass m and charge q is moving in a plane with kinetic energy E. If there exists a uniform magnetic field B, perpendicular to the plane of the motion, the proton will move in a circular path of radius

A. $\frac{2Em}{qB}$

B. $\frac{\sqrt{2Em}}{qB}$

C. $\frac{\sqrt{Em}}{2qB}$

D. $\sqrt{\frac{2Eq}{mB}}$

Answer:

Watch Video Solution

5. A stream of elecrtons and protons are directed towards a narrow slit on a screen [Fig. 1.130]. The intervening region has a uniform electric field $\overrightarrow{E}$ (vertically downwards) and a uniform magnetic field $\overrightarrow{B}$ (out of the plane of the figure) as shown. Then

A. electrons and proton with speed $\left|\frac{\overrightarrow{E}}{\overrightarrow{B}}\right|$ will pass through the slit

B. protons with speed $\left|\frac{\overrightarrow{E}}{\overrightarrow{B}}\right|$ will pass through the slit, electrons of the same speed will not

C. neither electrons nor pronton will go through the slit irrespective of their speed

D. electrons will always be deflected upwards irrespective of their speed

Answer:

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6. Two praticles A and B, having equal charges, after being accelerated through the same potential difference enter a region of uniform magnetic field and the particles descrbe circular paths of radii R_1 and R_2 respectively. The ratio of the masses of A and B is

A. $\sqrt{R_1 / R_2}$

B. R_1 / R_2

C. $(R_1 / R_2)^2$

D. $(R_2 / R_1)^2$

Answer:

Watch Video Solution

7. An electron enters an electric field having intensity $\overrightarrow{E} = 3\hat{i} + 6\hat{j} + 2\hat{k} V. m^{-1}$ and a magnetic field having induction $\overrightarrow{B} = 2\hat{i} + 3\hat{j} T$ with a velocity $\overrightarrow{v} = 2\hat{i} + 3\hat{j} m. s^{-1}$. The magnitude of the force acting on the electron is (Given $e = -1.6 \times 10^{-19} C$)

A. $2.02 \times 10^{-18} N$

B. $5.16 \times 10^{-16} N$

C. $3.72 \times 10^{-17} N$

D. $4.41 \times 10^{-18} N$

Answer:

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8. A rectangular coil carrying current is placed in a nonuniform magnetic field. On that coil the total

A. force is non-zero

B. force is zero

C. torque is zero

D. torque is non-zero

Answer:

Watch Video Solution

9. The magnetic field due to a current in a straight wire segment of length L at a point on its perpendicular bisector at a distance $r(r > > L)$

A. decreases as $\frac{1}{r}$

B. decreases as $\frac{1}{r^2}$

C. decreases as $\frac{1}{r^3}$

D. approaches a finite limit as $r \rightarrow \infty$

Answer:

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10. The magnets of two suspended coil galvanometer are of the same strength so that they produce identical uniform magnetic fields in the region of the coils. The coil of the first one is in the shape of a square of side a and that of the second one is circular of radius $\frac{a}{\sqrt{\pi}}$. When the same current is passed throught the coils, the ratio of the torque experienced by the first coil to that rxperienced by the second one is

A. $1 : \frac{1}{\sqrt{\pi}}$

B. $1 : 1$

C. $\pi : 1$

D. $1 : \pi$

Answer:

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11. A proton is moving with a uniform velocity of $10^6 m. s^{-1}$ along the Y-axis, under the joint action of a magnetic field along Z-axis and an electric field of magnitude $2 \times 10^4 V.m^{-1}$ along the negative X-axis. If the electric field is switched off, the proton starts moving in a circle. The radius of the circle is nearly (given: $\frac{e}{m}$ ratio for proton $\approx 10^8 C.kg^{-1}$)

A. 0.5 m

B. 0.2 m

C. 0.1 m

D. 0.05 m

Answer:

12. Two long parallel wires separated by 0.1 m carry currents of 1A and 2A respectively in opposite directions. A third current-carrying wire parallel to both of them is placed in the same plane such that it feels no net magnetic force. It is placed at a distance of

A. 0.5 m from the 1st wire, towards the 2nd wire

B. 0.2 m from the 1st wire, towards the 2nd wire

C. 0.1 m from the 1st wire, away from the 2nd wire

D. 0.2 m from the 1st wire, away from the 2nd wire

Answer:

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13. A proton of mass m moving with a speed $v(<<c$, velocity of light in vacuum) completes a circular orbit in time T in a uniform magnetic field. If the speed of the proton is increased to $\sqrt{2}v$, what will be time needed to complete the circular orbit?

A. $\sqrt{2}T$

B. T

C. $\dfrac{T}{\sqrt{2}}$

D. $\dfrac{T}{2}$

Answer:

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14. A uniform current is flowing along the length of an infinite, straight, thin, hollow cylinder of radius R. The magnetic field B produced at a perpendicular distance d from the axis of the cylinder is plotted in a graph. Which of the following figures looks like the plot?

A.

B.

C.

D.

Answer:

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15. A circular loop of radius r of conducting wire connected with a voltage source of zero internal resistance produces a magnetic field B at its centre. If instead, a circular loop of radius 2r, made of same material having the same cross section is connected to the same cross section is connected to the same voltage source, what will be the magnetic field at its centre?

A. $\frac{B}{2}$

B. $\frac{B}{4}$

C. 2B

D. B

Answer:

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16. A light charged particle is revolving in a circle of radius r in electrostatic attraction of a static heavy particle with opposite charge. How does the magnetic field B at the centre of the circle due to the moving charge depend on r?

A. $B \propto \frac{1}{r}$

B. $B \propto \frac{1}{r^2}$

C. $B \propto \frac{1}{r^{3/2}}$

D. $B \propto \frac{1}{r^{5/2}}$

Answer:

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Jee Main

1. A conductor lies along the z-axis at $-1.5 \leq z < 1.5$ m and carries a fixed current fo $10. A$ in -ve z-direction [Fig. 1.134]. For a field $B = 300 \times 10^{-4} e^{-0.2x} \widehat{a}_y$, find the power required to move that conductor at constant speed to $x = 2.0, y = 0 \text{in} 5 \times 10^{-3} s$. Assume parallel motion along the x-axis. Here $\widehat{a}_x, \widehat{a}_y, \widehat{a}_z$ are unit ectors along x, y,z axes, repectively.

A. $1.57W$

B. $2.97W$

C. $14.85W$

D. $29.7W$

Answer:

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2. Two long current carrying thin, wires, both with current I, are held by insultating of length L and are in equilibrium as shown in the figure, with threads as shown in the figure, with threads making an angle θ with the vertial. If the wires have mass λ per unit lenght then the value of I is (g =gavitational acclearation)

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. $\sqrt{\frac{\pi g L}{\mu_0} \cos \theta}$

D. $\sqrt{\frac{\pi \lambda g L}{\mu_0} \tan \theta}$

Answer:

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3. Two coaxial solenoids of different radii carry current I in the same direction . Let $\overrightarrow{F}_1$ be the magnetic force on the inner solenoid due to the outer one and veF_2 be the magnetic force on the outer solenoid due to the inner one.

Then

A. $\overrightarrow{F}_1 = \overrightarrow{F}_2 = 0$

B. $\overrightarrow{F}_1$ is radialy inward and $\overrightarrow{F}_2$ is radially outwards

C. $\overrightarrow{F}_1$ is radially inward and $\overrightarrow{F}_2 = 0$

D. $\overrightarrow{F}_1$ is readially outward and $\overrightarrow{F}_2 = 0$

Answer:

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4. A reactangular loop of sides 10cm and 5 cm carrying a current I of 12A is placed in different orientations as shown in the figure below,

If there is a uniform magnetic field of $0.3T$ in the positive z direction, in which orientations the loop would be (i) stable equilibrium and (ii) unstable equilibrium ?

A. (a) and (b), respectively

B. (a) and (c), respectively

C. (b) and (d), respectively

D. (b) and (c), respectively

Answer:

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5. Two indentical wires A and B, each of length l, carryi the same current I. Wire 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, thne the ratio B_A / B_B is

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

B. $\frac{\pi^2}{16\sqrt{2}}$

C. $\frac{\pi^2}{16}$

D. $\frac{\pi^2}{8\sqrt{2}}$

Answer:

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6. When a current of 5 mA is passed through a galvanometer having a coil of resistance 15Ω, it show full scale defelction. The value of the resistance to be put in series range 0.10v is

A. $1.985 \times 10^3 \Omega$

B. $2.045 \times 10^3 \Omega$

C. $2.535 \times 10^3 \Omega$

D. $4.005 \times 10^3 \Omega$

Answer:

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7. An electron a, proton and an alpha particle having the same kinetic energy moving in circular orbits of radii r_e, r_p, r_α respectively in a uniform magnetic field B. The relation between r_e, r_p, r_α is

A. $r_e < r_p < r_\alpha$

B. $r_e < r_\alpha < r_p$

C. $r_e > r_p > r_e > r_\alpha$

D. $r_e < r_p < r_e < r_\alpha$

Answer:

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Aipmt

1. Two indentical long conducting wires AOB and COD are placed at right angles to each other, with one above other such that is their common point for the two. The wires carry I_1 and I_2 currents respectively. A point P is at a height d above the point O, with respect to the plane of the wires. the magnetic field at P

is,

A. $\frac{\mu_0}{2\pi d}\left(\frac{I_1}{I_2}\right)$

B. $\frac{\mu_0}{2\pi d}(I_1 + I_2)$

C. $\frac{\mu_0}{2\pi d}(I_1^2 - I_2^2)$

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

Answer:

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2. A wire carrying a current I has the shape as show in the adjoining figure. Linear parts of the wire are very long and paralll to x-axis while semicircular portion of radius R lying on the yz-plane. Magnetic field at point O is

A. $\overrightarrow{B} = \frac{\mu_0}{4\pi}\frac{I}{R}\left(\pi\hat{i} + 2\hat{k}\right)$

B. $\overrightarrow{B} = -\frac{\mu_0}{4\pi}\frac{I}{R}\left(\pi\hat{i} - 2\hat{k}\right)$

C. $\overrightarrow{B} = -\frac{\mu_0}{4\pi}\frac{I}{R}\left(\pi\hat{i} + 2\hat{k}\right)$

D. $\overrightarrow{B} = \frac{\mu_0}{4\pi}\frac{I}{R}\left(\pi\hat{i} - 2\hat{k}\right)$

Answer:

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3. An electron moving in a circular orbit of radius makes n rotations per second. The magnetic field produced at the centre has magnitude :

A. $\frac{\mu_0 \text{ne}}{2\pi r}$

B. Zero

C. $\frac{\mu_0 n^2 e}{r}$

D. $\frac{\mu_0 \text{ne}}{2r}$

Answer:

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Neet

1. A square loop ABC carrying a current i is placed near and coplanar with a long straight conductor XY carrying a current I. The net force on the loop will be

A. $\frac{\mu_0 I i}{2\pi}$

B. $\frac{2\mu_0 I i L}{3\pi}$

C. $\frac{\mu_0 I i L}{2\pi}$

D. $\frac{2\mu_0 I i}{3\pi}$

Answer:

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2. A long straight wire of radius a carries a steady current I. The current is uniformly distributed over its cross section. The ratio of the magntic fields B and B' at radii distance $\frac{a}{2}$ and $2a$ respectively, from the axis of the wire is

A. $\frac{1}{2}$

B. 1

C. 4

D. $\frac{1}{4}$

Answer:

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3. An electron moves straight inside a charged parallel plate capacitor of uniform charge density σ. The space between the plates in filled uniform magnetic field of intensity B, as shown in the figure. Neglecting effect of gravity, the time of striaght line motion of the electron in the capacitor is

A. $\dfrac{\varepsilon_0 lB}{\sigma}$

B. $\dfrac{\sigma}{e\pi s_0 lB}$

C. $\dfrac{\varepsilon_0 B}{\sigma}$

D. $\dfrac{\sigma}{e\pi s_0 B}$

Answer:

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4. A uniform magnetic field of $0.3T$ is established along the positive Z-direction. A rectangular loop in Xy-plane of sides 10 cm and 5 cm carreis a current of $I = 12A$ as shown. To torque on the loop is

A. $+1.8 \times 10^{-2} \hat{i} N \cdot m$

B. $-1.8 \times 10^{-2} \hat{j} N \cdot m$

C. zero

D. $-1.8 \times 10^{-2} \hat{i} N \cdot m$

Answer:

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5. A metallic rod of mass per unit length 0.5 kg m^{-1} is lying horizontally on a smooth inclined plane which makes an anlge of 30° with the horizontal. The rod is not allowed to slide down by flowing a current through it when a magnetic field of induction 0.25 T is acting on it in the vertical direction. The current flowing in the rod to keep it stationary

A. $14.76A$

B. $5.98A$

C. $7.14A$

D. $11.32A$

Answer:

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6. Current sensitivity of a moving coil galvanometer is 5 div/mA and its voltage senstivity (angular deflection per unit voltage applied) is 20 div/V. The resistance of the galvanometer is

A. 250Ω

B. 25Ω

C. 40Ω

D. 500Ω

Answer:

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Cbse Scanner

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

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2. Explain giving resons reasons the basic difference in converting a galvanometer into (i) a voltmeter and (ii) an ammeter.

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3. Two long straight parallel conducts carrying steady currents I_1 and I_2 are separated by a distance d. Explain briefly with the help of suitable diagram, how the magnetic field due to one conductor acts on the other. Hence deduce the expression for the force acting between the two conductors. Mention the nature of this force.

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4. A wire AB is carrying a steady currents of 12 A and is lying on a table. Another wire CD carrying 5A is held directly above BA at a height of 1 mm. Find the mass per unit length of the wire CD so that it remains suspended at its position when left free. Give the direction of the current flowing in CD with respect to that in AB. [Take the value of $g = 10m \cdot s^{-2}$]

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5. Using Biot-Svart's law, derive the expression for the magnetic field in vector form at a point on the axis of a circular current loop.

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6. What does a toroid consist of ? Find out the expression for the magnetic field inside a toriod for N turns of the coil having an average radius r and carrying current I. show that the magnetic field in the open space inside and outside the torroid is zero.

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7. What do you mean by current sensitivity of a galvanometers ? Write its SI unit.

Watch Video Solution

8. Draw a schematic sketch of a cyclotron. Explain clearly the role of crossed electric and magnetic fields in accelerating the charge. Hence derive the expression for the kinetic energy by the particles.

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9. An α-particle and a proton are released from the centre of a cyclotron and made to accelerate. Can both be accelerated at the same cyclotron frequency ? Give reason to justify your answer.

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10. An α-particle and a proton are released from the centre of a cyclotron and made to accelerate. When they are accelerated, in turn, which of the two will have higher velocity at the exit slit of the does ?

Watch Video Solution

11. Deduce an expression for the frequency of revolution of a charged particle in a magnetic

field and show that it is independent of the velocity or energy of the particle.

Watch Video Solution

12. Draw a schematic sketch of a cyclotron. Explain, giving the essential detail of its construction, how it is used to accelerated a charged particle.

Watch Video Solution

13. Draw a labelled diagram of a moving coil galvanometer. Describe briefly its principle and working.

Watch Video Solution

14. Answer the following why is it necessary to introduce a cylindrical soft iron core inside the coil of a galvanometer ?

Watch Video Solution

15. Answer the following Increasing the current sensitivity of a galvanometer may not necessarily increases its voltage sensitivity. Explain giving reasons.

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16. Asha's uncle was advised by his doctor to have an MRI(magnetic resonance imaging) scan of his brain. Her uncle felt that it was too expensive and wanted to postpone it. When Asha learnt about this, she took the help of her family and when she approached the doctor, he also offered a substantial discount. She thus convinced her uncle to undergo the rest to enable the doctor to know the condition of his brain. the reusling information greatly helped his doctor to treat him properly.

Based on the above paragraph, answer the following questions.

What according to you are the values displayed by Asha,her family and the doctor?

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17. Asha's uncle was advised by his doctor to have an MRI(magnetic resonance imaging) scan of his brain. Her uncle felt that it was too expensive and wanted to postpone it. When Asha learnt about this, she took the help of her family and when she approached the4 doctor, he also offered a substantial discount. She thus convinced her uncle to undergo the rest to enable the doctor to know the condition of his brain. the reusling information greatly helped his doctor to treat him properly.

Based on the above paragraph, answer the following questions.

What in view could be the reason for MRI test to be expensive ?

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18. Asha's uncle was advised by his doctor to have an MRI(magnetic resonance imaging) scan of his brain. Her uncle felt that it was too expensive and wanted to postpone it. When Asha learnt about this, she took the help of her family and when she approached the doctor, he also offered a substantial discount. She thus convinced her uncle to undergo the rest to enable the doctor to know the condition of his brain. the reusling information greatly helped his doctor to treat him properly.

Based on the above paragraph, answer the following questions.

Assuming thet MRI was perpformed using a magnetic field of $0.1T$. find teh maximum and minimum values of the force that the magnetic field could exert on a proton (Charge

$= 1.6 \times 10^{-19} C)$ that was moving with a speed of $10^4 m / s$.

Watch Video Solution

19. What can be the cause of helical motion of charged particle ?

Watch Video Solution

20. State Ampere's circuital law. Use this law to find the magnetic field due to a straight

infinite current carrying wire. How are the magnetic fields lines different from the electrostatic field lines ?

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21. State the principle of a cyclotron. Show that the time period of revolution of particles in a cyclotron is independent of their speed, Why is this property necessary for the operation of a cyclotron ?

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22. Obtain the expression for the cyclotron frequency.

Watch Video Solution

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

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

Watch Video Solution

25. Two indentical circular coils, P and Q each of radius R, carrying currents 1A and $\sqrt{3}A$ resepectively. Are placed concentrically and perpendicular to each other laying in the XY and Yz planes. Find the magnitude and direction of the net magnetic field at the centre of the coils.

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26. Two identical loops P and Q each of radius 5 cm are laying in perpendicular planes such that they have a common centre as shown in the figure. Find the magnitude and direction of the net magnetic field at the common centre of the two coils, if they carry currents equal to 3A and 4A respectively.

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