Chapter- 04

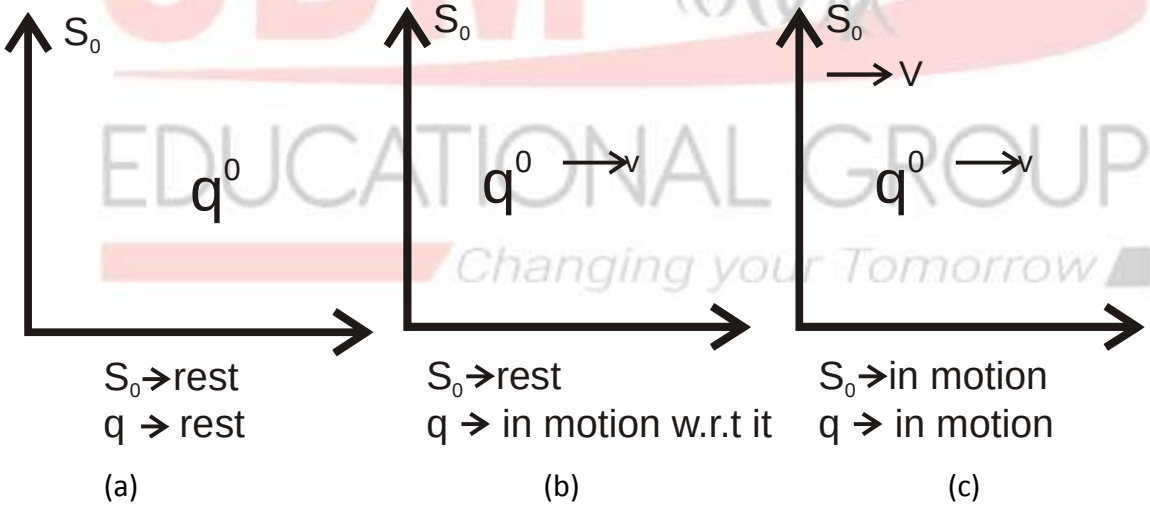
Moving Charge Magnetism

01. What is S.I. unit of the magnetic field?

02. What is the direction of force acting on a charged particle 'q' moving with velocity v, in a magnetic field B. ***[CBSE-2008]***

03. If the magnetic field is parallel to the +ve y-axis and the charged particle is moving along the +ve x-axis, which way would Lorentz force be for (a) an e^- (-ve charge) (b) proton (+ve charge). ***[CBSE-2009]***

04. Charges in motion relative to an observer produce a magnetic field as well as an electric field. In which case both electric and magnetic field is zero?



05. State the dimensional formula for Magnetic Induction.

06. Write the Biot-Savart's law in vector form.

07. State the dimensional formula for $\mu_0\varepsilon_0$.

08. Draw the graph showing the variation of the magnetic field (B) with distance from the center of a circular current-carrying conductor.

09. What is the resistance of an ideal voltmeter?

Short Answer Type Questions (2 marks)

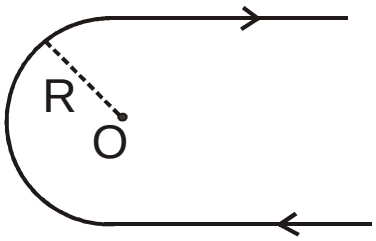
10. A proton and a deuteron move with a certain velocity in a uniform magnetic field. Compare the Lorentz force acting on the two particles?

11. With the help of a charged particle, how would you identify whether the given field is magnetic or electrostatic in nature.

12. Show that the power due to the force exerted by the magnetic field on a moving charge is zero.

13. Find the magnetic field at the point 'O' in a current-carrying wire has the shape shown in the fig. The radius of the curved part of the wire is R, the linear parts are assumed to be very long.

(a) (b) (c)

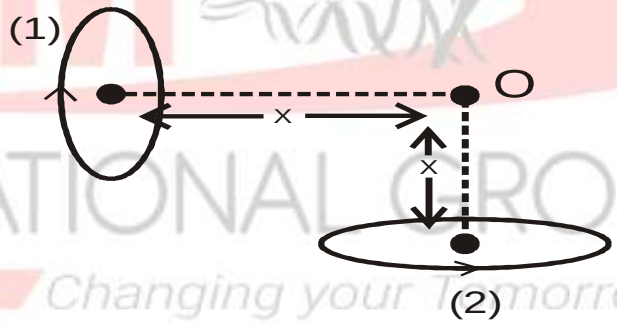


(d)

Short Answer Type Questions (3 marks)

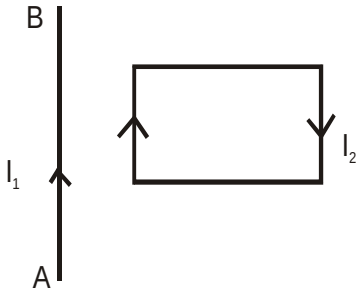
14. A proton, a deuteron, and an -particle moves with the same K.E enters normally to a uniform magnetic field. Calculate the ratio of the radii of the three particles.

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



16. A straight thick long wire of uniform cross-section of radius 'a' is carrying a steady current 'I'. Use Ampere's circuital law to obtain relation showing the variation of the magnetic field (B) inside and outside the wire with distance 'r' of the field point from the center of its cross-section. ***[NCERT Example]***

17. In the fig, the straight wire AB is fixed while the loop is free to move under the influence of the electric current flowing in them. In which direction does the loop begin to move? Give the reason for your answer.



18. With the help of a schematic sketch of a cyclotron and explain it's working principle.

19. Derive a mathematical expression for the force per unit length experienced by two parallel current-carrying wires. Hence define one ampere of current.

20. With the help of a neat and labeled diagram, explain the underlying principle and working of a moving coil Galvanometer. What is the function of

(i) Uniform radial field (ii) Soft iron core in such a device.

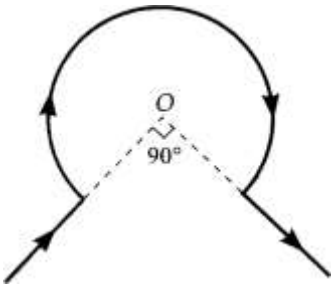
Define the current sensitivity and voltage sensitivity of a moving coil galvanometer. The change of current sensitivity does not mean to the change of voltage sensitivity. Justify.

21. **.** A wire placed along the north-south direction carries a current of 8A from south to north. Find the magnetic field due to a 1 cm piece of wire at a point 200 cm northeast from the piece.

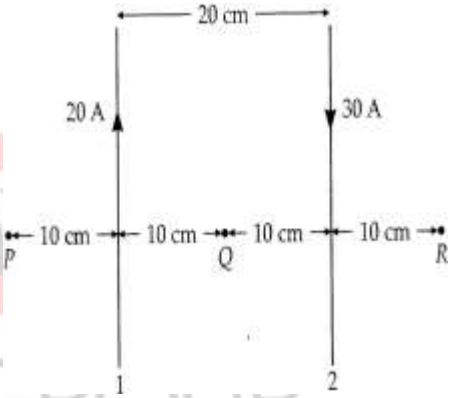
22. An element $\Delta\vec{\ell} = \Delta x\hat{i}$ is placed at the origin and carries a large current $I = 10A$. What is the magnetic field on the y-axis at a distance of 0.5m. $\Delta x = 1cm$.

23. In the Bohr model of the hydrogen atom, an electron revolves around the nucleus in a circular orbit of radius 5.11×10^{-11} Hz. What radius 5.11×10^{-11} m at a frequency of 6.8×10^{15} Hz. What is the magnetic field set up at the center of the orbit?

24. The wire shown in figure carries a current of 10A. Determine the magnitude of the magnetic field at the center O. Give radius of the bent coil is 3 cm



25. The figure shows two current-carrying wires 1 and 2. Find the magnitude and directions of the magnetic field at points P, Q, and R.



26. A 0.5 m long solenoid has 500 turns and has a flux density of $2.52\times10^{-3}T$ at the center. Find the current in the solenoid. Given $\mu_0 = 4\pi\times10^{-7}\,Hm^{-1}$.

27. A proton enters a magnetic field of flux density 2.5 T with a velocity of $1.5\times10^{7}\,ms^{-1}$ at an angle of 30° with the field. Find the force on the proton.

28. An electron after being accelerated through a potential difference of 10^4 V enters a uniform magnetic field of 0.04 T perpendicular to its direction of motion. Calculate the radius of the curvature of its trajectory.

29. In a cyclotron, a magnetic induction of 1.4 T is used to accelerate protons. How rapidly should the electric field between the dees be reversed? The mass and charge of the proton are $1.67\times10^{-27}\,kg\ and\ 1.6\times10^{-19}\,C$ respectively.

30..A current of 5.0 A is flowing upward in a long vertical wire placed in a uniform horizontal northward magnetic field of 0.02 J. How much force and in what direction will the riled exert on 0.06 m length of the wire?

31. A rectangular coil of sides 8 cm and 6 cm having 2000 turns and carrying a current of 200 MA is placed in a magnetic field of 0.2 T directed along X-axis

(a) What is the maximum torque the coil can experience? In which orientation does it experience the maximum torque?

(b) For which orientation of the coil is the torque zero? When is this equilibrium stable and when is it unstable?

32. A rectangular coil of area 100 cm^2 and consisting of 100 turns is suspended in a magnetic field of $5\times10^{-2}T$. What current should be made to pass through it in order to keep equilibrium at an angle of 45^0 with the field? Given that torsion constant of the suspension fiber is $10^{-8}Nm\deg^{-1}$

33.. A galvanometer with a coil of resistance 12.0Ω shows full-scale deflection for a current 2.5 mA. How will you convert the meter into (a) an ammeter of range 0 to 7.5 A (b) a voltmeter of range 0 to 10.0 V? Determine the net resistance of the meter in each case. When an ammeter is put in a circuit, does it read 9slightly) less or more than the actual current in the original circuit? When a voltmeter is put across a part of the circuit, does it read (slightly) less or more than the original voltage drop? Explain.

MODEL QUESTIONS

01. An e^- is moving along the +ve x-axis where the magnetic field is along the +ve y-axis. What is the direction of the Lorentz force?

02. An e^- is moving towards +ve z-axis, deflected by a force towards the +ve y-axis. Find the direction of the magnetic field.

03. What is the direction of force acting on a charged particle q moving with velocity v, moving in the magnetic field?

04. An e^- and proton moving parallel to each other in the same direction with equal momenta enters into a uniform magnetic field which is at the right angle to their velocities. Trace their trajectory in the magnetic field.

05. A charged particle enters into a uniform magnetic field and experiences an upward force. What sign of the charged particle?

06. In a certain arrangement, a proton does not get deflected while passing through a magnetic field region under what condition is it possible?

07. An e^- the gun is fired eastward horizontally find the direction in which it will be deflected due to the influence of the earth's magnetic field.

08. How do you convert a galvanometer into an ammeter? why is an ammeter always connected in series?

09. What is the value to the earth's magnetic field?

10. What is the radius of the path of an e^- (mass $9x10^{-31}$ kg and charge $1.6x10^{-19}$ c) moving at a speed of $3x10^7$ m/s in a magnetic field of $6x10^{-1}$ Tesla to it? What is its frequency? Calculate its energy in Kev ($1ev=1.6x10^{-14}J$).

11. An e^- and a proton moving with the same K.E in a uniform magnetic field perpendicular to their direction of motion where the radius is larger provided their K.E is the same.

12. An electron and a proton moving with the same velocity enters normally to a uniform magnetic field whose radius is larger and by how much?

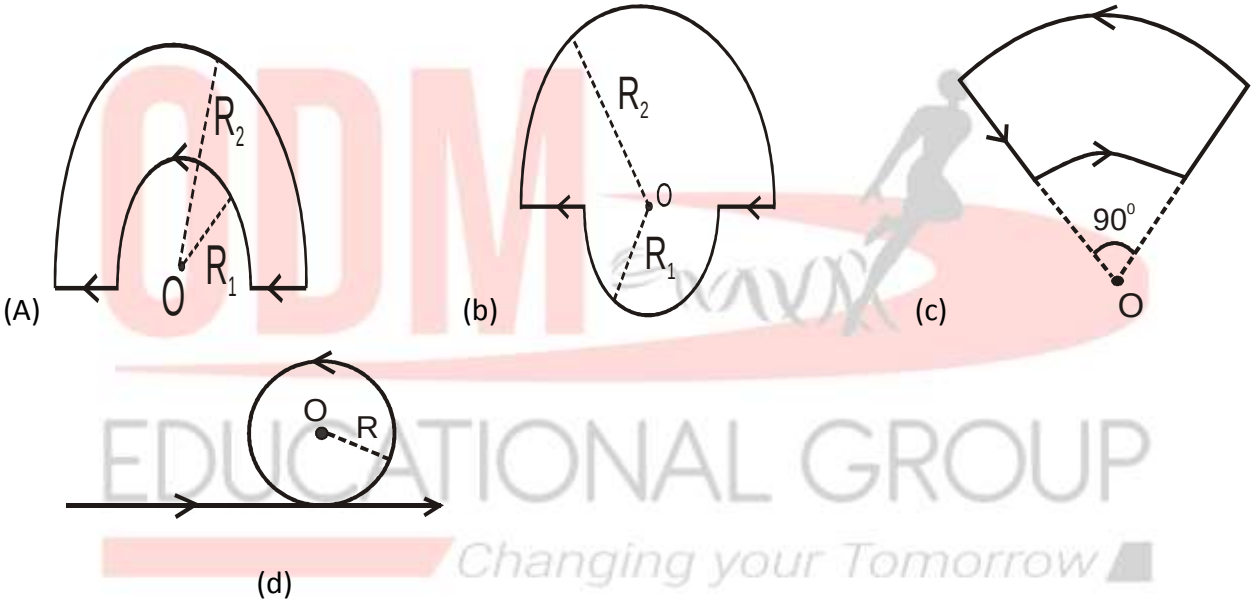
13. A proton and an α -particles enter normally to a uniform magnetic field. Calculate the ratio of their time period as well as radii of the circular path.

14. An e^- after being moved through a potential difference of 100V, enters into a uniform magnetic field of 0.004 Tesla. Calculate the radius of the path covered by the electron.

15. State the important limitations in accelerating a light elementary particle such as electron to high energies.

16. A cyclotron oscillator frequency is 10 MHz. (i) What should be the operating magnetic field for accelerating proton, (ii) If the radius of the disc is 60 cm, what is the K.E in (Mev) of the proton beam produced by the accelerator? (mass of proton = 1.6×10^{-27}kg, e=1.6×10^{-19}C, 1 Mev=1.6×10^{-13}J, V=10^{7}).

17. Find the magnetic field at point 'O' in the current-carrying wire has the shape as shown in the fig.



18. Give expression for Ampere's circuital law.

19. To increase the current sensitivity of a moving coiled galvanometer by 50%, its resistance is increased. So that the new resistance becomes twice its initial resistance. By what factor does its voltage sensitivity change?

20. Why should an ammeter have a low resistance?

21. How can a moving coil galvanometer be converted into a voltameter?