Home Assignment – 04

UNIT – III MOVING CHARGES AND MAGNETISM

Chapter – 4 MOVING CHARGES AND MAGNETISM

CBSE 2023 (Compartment)

(SET – 1)

1. An electron with velocity $\vec{v} = \vec{v}_x\,\hat{\imath} + \vec{v}_y\,\hat{\jmath}$ moves through a magnetic field $\vec{B} = \vec{B}_x - \vec{B}_y$ The force $\vec{F}$ on the electron is : (e is the magnitude of its charge)

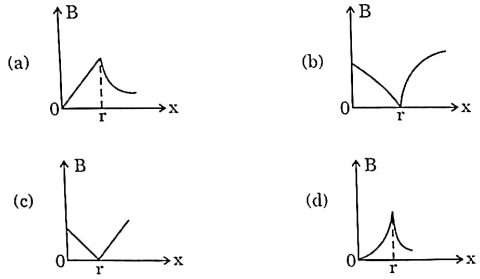
   (a) $-e\left(v_x B_y - v_y B_x\right)\hat{k}$ (b) $e\left(v_x B_y - v_y B_x\right)\hat{k}$
   (c) $-e\left(v_x B_y + v_y B_x\right)\hat{k}$ (d) $e\left(v_x B_y + v_y B_x\right)\hat{k}$

2. Assertion (A) : A planar loop of irregular shape carrying current is subjected to a magnetic field acting perpendicular to the plane of the loop. If the wire if flexible, the loop takes a circular shape.
   Reason (R) : The force acting on each point of a current carrying loop, in a magnetic perpendicular to its plane, is radially outwards.

3. (a) It is not advisable to use a galvanometer as such to measure current directly. Why?
   (b) Why should the value of resistance connected in parallel to a galvanometer be low?
   (c) Is the reading shown by an ammeter in a circuit less than or more than the actual value of current flowing in the circuit ? Why ?

(SET – 3)

1. The current I flowing through a conductor of radius r is uniformly distributed across its cross-section. Which of the following graphs represents the variation of magnitude of magnetic field $\vec{B}$ with distance x from the axis of the conductor ?



2. Assertion (A) : A proton and an alpha particle having same kinetic energy are moving in circular paths in a uniform magnetic field. The radii of their circular paths will be equal.
   Reason (R) : The centripetal force required to move a charged particle in a circle does not depend on the magnitude of the magnetic field.

CBSE 2023

(SET - 1)

1. Beams of electrons and protons move parallel to each other in the same direction. They

   (a) attract each other (b) repel each other. (c) neither attract nor repel
   (d) force of attraction or repulsion depends upon speed of beams.

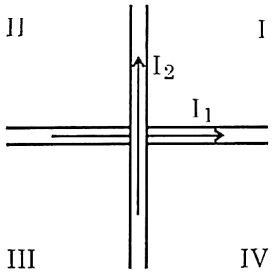
2. Along straight wire of radius 'a' carries a steady current 'I'. The current is uniformly distributed across its area of cross-section. The ratio of magnitude of magnetic field $\vec{B}_1$ at $\frac{a}{2}$ and $\vec{B}_2$ at distance 2a is

   (a) $\frac{1}{2}$ (b) 1 (c) 2 (d) 4

3. Briefly explain why and how a galvanometer is converted into an ammeter. (2)

CBSE 2022

1. Two wires carrying currents I_1 and I_2 lie, one slightly above the other, in a horizontal plane as shown in figure. The region of vertically upward strongest magnetic field is



(a) I (b) II (c) III (d) IV

2. Two parallel conductors carrying currents of 4.0 A and 10.0 A are placed 2.5 cm apart in vacuum. The force per unit length between them is –

(a) 6.4×10^{-5} N/m (b) 6.4×10^{-2} N/m
(c) 4.6×10^{-4} N/m (d) 3.2×10^{-4} N/m

3. If an ammeter is to be used in place of voltmeter, then we must connect with the ammeter a –

(a) low resistance in parallel (b) low resistance in series
(c) high resistance in parallel (d) high resistance in series

4. The magnetic field at the centre of a current carrying circular loop of radius R, is B_1. The magnetic field at a point on its axis at a distance R from the of the loop is B_2. Then the ratio B_1/B_2 is

(a) $2\sqrt{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) $\sqrt{2}$ (d) 2

5. A current carrying wire is kept in a uniform magnetic field, will experience a maximum force when it is

(a) perpendicular to the magnetic field (b) parallel to the magnetic field
(c) at an angle 45^0 to the magnetic field (d) at an angle 60^0 to the magnetic field

6. A straight conducting rod of length *l* and mass m is suspended in a horizontal plane by a pair of flexible strings in a magnetic field of magnitude B. To remove the tension in the supportive stings, the magnitude of the current in the wire is

(a) $\frac{mgB}{l}$ (b) $\frac{mgl}{B}$ (c) $\frac{mg}{Bl}$ (d) $\frac{l\,B}{mg}$

7. A proton and an alpha particle move in circular orbits in a uniform magnetic field. Their speeds are in the ratio of 9 : 4. The ratio of radii of their circular orbits $\frac{r_p}{r_{alpha}}$ is

(a) $\frac{3}{4}$ (b) $\frac{4}{3}$ (c) $\frac{8}{9}$ (d) $\frac{9}{8}$

8. A bar magnet has magnetic dipole moment $\overrightarrow{M}$. Its initial position is parallel to the direction of uniform magnetic field $\overrightarrow{B}$. In this position, the magnitudes of torque and force acting on it respectively are –

(a) 0 and MB (b) MB and MB (c) 0 and 0 (d) $|\overrightarrow{M} \times \vec{B}|$ and 0

9. Assertion (A) : The poles of a bar magnet cannot be separated.
Reason (R) : Magnetic monopoles do not exist.

CBSE 2020

(SET – 1)

1. An electron is released from rest in a region of uniform electric and magnetic field acting parallel to each other. The electron will
   (a) move in a straight line (b) move in circle
   (c) remain stationary (d) move in helical path

2. An ammeter of resistance 0.8 Ω can measure current up to 1.0 A. Find the value of shunt resistance required to convert this ammeter to measure a current up to 5.0 A. (2)

3. (a) A circular loop of radius R carries a current I. Obtain the expression for the magnetic field at the point on its axis at a distance x from its centre. A conducting rod of length 2 m is placed on a horizontal table in north –south direction. It carries a current of 5 A from south to north. Find the direction and the magnitude of the magnetic force acting on the rod. Given that the earth's magnetic field at the place is 0.6×10^{-4} T and the angle of dip is $\frac{\pi}{6}$. (5)

4. (a) Obtain the expression for the deflecting torque acting on the current carrying rectangular coil of a galvanometer in a uniform magnetic field. Why is a radial magnetic field employed in the moving coil galvanometer?
   (b) Particles of mass 1.6×10^{-27} kg and charge 1.6×10^{-19} C are accelerated in a cyclotron of dee radius 40 cm. it employs a magnetic field 0.4 T. Find the kinetic energy (in MeV) of the particle beam imparted to the accelerator. (5)

(SET – 2)

1. A galvanometer of resistance 16 Ω shows full scale deflection for a current of 4 mA. How will you convert it into a voltmeter to measure a voltage up to the critical voltage. (2)

(SET – 3)

1. A straight current carrying conductor is placed inside a uniform magnetic field. The force per unit length acting on the conductor is
   (a) maximum when the conductor is perpendicular to the direction of magnetic field.
   (b) maximum when the conductor is along the direction of magnetic field.
   (c) minimum when the conductor is perpendicular to the direction of magnetic field.
   (d) minimum when conductor makes an angle of 45^0 with the direction of magnetic field.

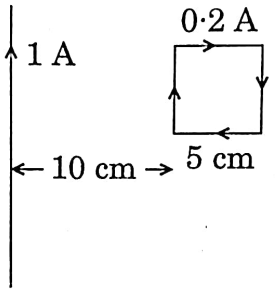
2. A circular loop carrying a current 5 A, produces a magnetic field of π mT, at its centre. Find the value of magnetic moment of the loop. (2)

CBSE 2019

1. A proton is accelerated through a potential difference V, subjected to a uniform magnetic field acting normal to the velocity of the proton. If the potential difference is doubled, how will the radius of the circular path described by proton in the magnetic field change ? (1)

2. Prove that the magnetic moment of the electron revolving around a nucleus in an orbit of radius r with orbital speed v is equal to $\frac{evr}{2}$. Hence using Bohr's postulate of quantisation of angular momentum, deduce the expression for the magnetic moment of hydrogen atom in the ground state. (3)

3. A square loop of ide 5 cm carrying a current of 0.2 A in the clockwise direction is placed at a distance of 10 cm from an infinitely long wire carrying a current of 1A as shown. Calculate (i) the resultant magnetic force, and (ii) the torque, if any, acting on the loop. (3)



CBSE 2018

1. A proton and an electron travelling along parallel paths enter a region of uniform magnetic field, acting perpendicular to their paths. Which of them will move on a circular path with higher frequency? (1)

2. An iron ring of relative permeability μ_r has windings of insulated copper wire of n turns per metre. When the current in the windings is I, find the expression for the magnetic field in the ring. (2)

CBSE 2017

1. Find the condition under which the charged particles moving with different speeds in the presence of electric and magnetic field vectors can be used to select charged particles of a particular speed. (2)

2. (a) State Biot- Savart law and express this law in vector form.
Two identical circular coil, P and Q each of radius R, carrying currents 1 A and $\sqrt{3}$ A respectively, are placed concentrically and perpendicular to each other lying in XY and YZ planes. Find magnitude and direction of the net magnetic field at centre of coils. (3)

CBSE 2016

1. Use Biot-Savart law to derive the expression for the magnetic field on the axis of a current carrying circular loop of radius 'R'. Draw the magnetic field lines due to a circular wire carrying current 'I'. (3)

CBSE 2015

1. A uniform magnetic field **B** is set up along the positive x-axis. A particle of charge 'q' and mass 'm' moving with velocity '**v**' enters the field at the origin X-Y plane such that it has velocity components both along and perpendicular to the magnetic field. Trace, giving reason, the trajectory followed by the particle. Find out the expression for the distance moved by the particle along the magnetic field in one rotation. (3)

2. (a) Explain, using a labelled diagram, the principle and working of a moving coil galvanometer. What is the function of (i) uniform radial magnetic field, (ii) soft iron core?
(b) Define the terms (i) current sensitivity and (ii) voltage sensitivity of a galvanometer.
(c)Why does increasing the current sensitivity not necessarily increase voltage sensitivity? (5)

3. (a) Write, using Biot- Savart law, the expression for the magnetic field '**B**' due to an element '**dl**' carrying a current 'I' at a distance 'r' from it in vector form. Hence derive the expression for the magnetic field due to a current carrying loop of radius 'R' at a point P distant 'x' from its centre along the axis of the loop.
(b) Explain how Biot-Savart law enables one to express the Ampere's circuital law in the integral form. (5)

CBSE 2014

1. Using the concept of force between two infinitely long parallel current carrying conductors, define one ampere of current. (1)

2. (a) Deduce an expression for the frequency of revolution of a charged particle in a magnetic field and show that it is independent of velocity or energy of the particle.
(b) Draw a schematic sketch of a cyclotron. Explain, giving the essential details of its construction, how it is used to accelerate the charged particles. (5)

3. (a) Draw a labeled diagram of a moving coil galvanometer. Describe briefly its principle and working.
(b) Answer the following :
(i) Why is it necessary to introduce a cylindrical soft iron core inside the coil of the galvanometer?
(ii) Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity. Explain, giving reason. (5)

CBSE 2013

1. A wire AB is carrying a steady current of 12 A and is lying on the table. Another wire CD carrying 5 A is held directly above AB 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 = 10 ms^{-1}) (3)

2. (a) Using Biot – Savart law, derive the expression for the magnetic field in the vector form at a point on the axis of a circular current loop.

CBSE 2012

1. A circular coil of 'N' turns and radius 'R' carries a current 'I'. it is unwound and rewound to make another coil of radius 'R/2', current 'I' remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil. (2)

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2. A rectangular loop of size *l* x b carrying a steady current 'I' is placed in uniform magnetic field '**B**'. Prove that the torque '$\boldsymbol{\tau}$' acting on the loop is given by $\boldsymbol{\tau} = \mathbf{m} \times \mathbf{B}$, where '**m**' is the magnetic moment of the loop. (3)

3. (a) Explain, giving reasons, the basic difference in converting a galvanometer into (i) a voltmeter and (ii) an ammeter.
(b) Two long straight parallel conductors carrying steady currents 'I_1' and 'I_2' are separated by a distance 'd'. Explain briefly, with the help of a 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. (5)