INDIAN SCHOOL MUSCAT

CLASS : XII

SUBJECT: PHYSICS

WORKSHEET-4

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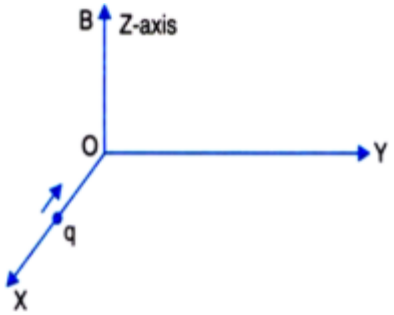
CHAPTER 4.MOVING CHARGES AND MAGNETISM

SECTION A CONCEPTUAL AND APPLICATION TYPE QUESTIONS

1 An electron does not suffer any deflection while passing through a region of uniform magnetic field. What is the direction of the magnetic field?

2 A charge q moving along the X-axis with a velocity $\vec{v}$ is subjected to a uniform magnetic field $\vec{B}$ acting along the Z-axis as it crosses the origin O. (i) Trace its trajectory? (ii) Does the charge gain kinetic energy as it enters the magnetic field?



3 Write the expression, in a vector form, for the magnetic Lorentz force $\vec{F}$ experienced by a change q moving with velocity $\vec{v}$ in a magnetic field $\vec{B}$. What is the direction of the magnetic force?

4 Why a cyclotron cannot accelerate i) a neutron ii) an electron?

5 A moving charged particle enters a magnetic field and emerges out from it .Will it kinetic energy i)increase ii)decrease or iii) remain unchanged ?

6 A charged particle of charge q enters a uniform magnetic field B, with a velocity v experiences a force F, identify a minimum of two pair of perpendicular vectors among the parameters mentioned.

7 A circular loop carries a current of I in clockwise direction, draw a diagram to show the coil and magnetic field lines associated with it.

8 What is the path of a charged particle moving in a magnetic field in a direction i) parallel ii) at an acute angle iii) perpendicular to the magnetic field?

9 An α particle and a proton enter a uniform magnetic field with same speed in the perpendicular direction, compare the (i) radii of their circular paths (ii) ratio of their time periods.

10 (a) Using Biot-savart's law, derive the expression for the magnetic field in the vector form at a point on the axis of a circular current loop.
(b) What does a toroid consist of? Find out the expression for the magnetic field a toroid for N turns of the coil having the average radius r and carrying a current I. Show that the magnetic field in the open space inside and exterior to the toroid is zero.
(c) In what respect is a toroid different from a solenoid? Draw and compare the pattern of the magnetic field lines in the two cases.

11 State the underlying principle of working of a moving coil galvanometer. Write two reasons why a galvanometer cannot be used as such to measure current in a given circuit. Name any two factors on which the current sensitivity of a galvanometer depends.

12 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.

13 (a) Draw a schematic sketch of a cyclotron. Explain clearly the role of crossed electric and magnetic field in accelerating the charge. Hence derive the expression for the kinetic energy acquired by the particles.
(b) An - particle and a proton are released from the center of the cyclotron and made to accelerate.
(i) Can both be accelerated at the same cyclotron frequency? Give reason to justify your answer.
(ii) When they are accelerated in turn, which of the two will have higher velocity at the exit slit of the Dees?

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

15 A proton, a deuteron and an alpha particle, are accelerated through the same potential difference and then subjected to a uniform magnetic field $\vec{B}$, perpendicular to the direction of their motions. Compare (i) their kinetic energies, and (ii) if the radius of the circular path described by proton is 5cm, determine the radii of the paths described by proton is 5cm, determine the radii of the paths described by deuteron and alpha particle.

SECTION B NUMERICAL PROBLEMS

1 A circular coil of 20 turns and radius 10 cm is placed in a uniform magnetic field of 0.1 T normal to the plane of the coil. If the current in the coil is 5.0 A, what is the
(i) total torque on the coil,
(ii) total force on the coil
(iii) average force on each electron in the coil due to the magnetic field?

The coil is made of copper wire of cross-sectional area $10^{-5}m^2$, and the free electron density in copper is given to be about $10^{29}m^{-3}$

2 Two concentric circular coils X and Y of radii 16 cm and 10 cm, respectively, lie in the same vertical plane containing the north to south direction. Coil X has 20 turns and carries a current of 16 A; coil Y has 25 turns and carries a current of 18 A. The sense of the current in X is anticlockwise, and clockwise in Y, 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.

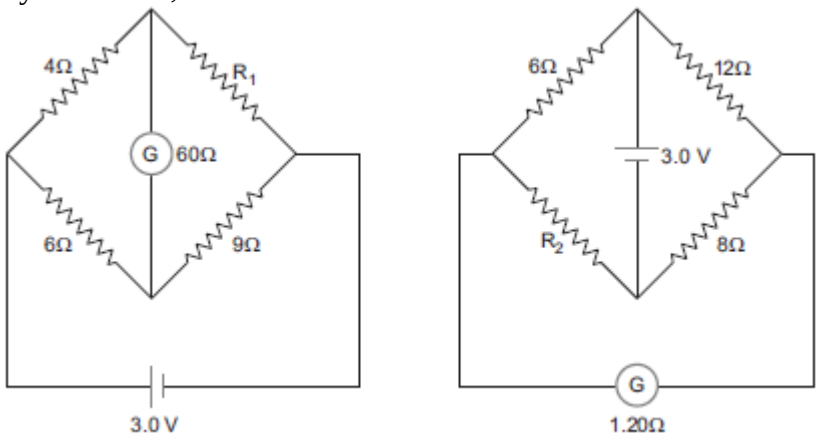
3 A moving coil galvanometer has a resistance of 10Ω , and produces full scale deflection for a current of 25mA. How can the instrument be adopted to measure
i) voltages upto120V ii)currents upto 20A?

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

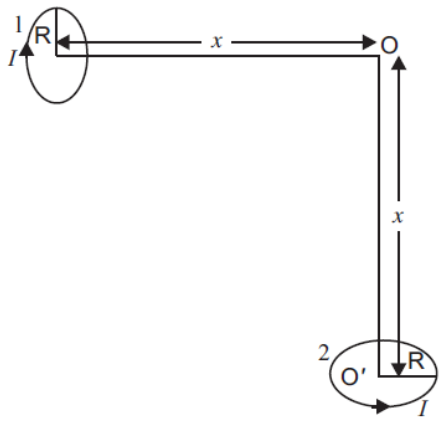
5 Two long and parallel straight wires A and B carrying currents of 8.0 A and 5.0 A in the same direction are separated by a distance of 4.0 cm. Estimate the force on a 10 cm section of wire A.

6 In a chamber, a uniform magnetic field of 6.5 G (1 G = 10^{-4} T) is maintained. An electron is shot into the field with a speed of 4.8×10^6 m s^{-1} normal to the field. Explain why the path of the electron is a circle. Determine the radius of the circular orbit. ($e = 1.5 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg)

7 Define the current sensitivity of a galvanometer. Writer its S.I. unit. Figure shows two circuits each having galvanometer and a battery of 3 V. when the galvanometers in each arrangement do not show any deflection, obtain the ratio $\boldsymbol{R_1/R_2}$.

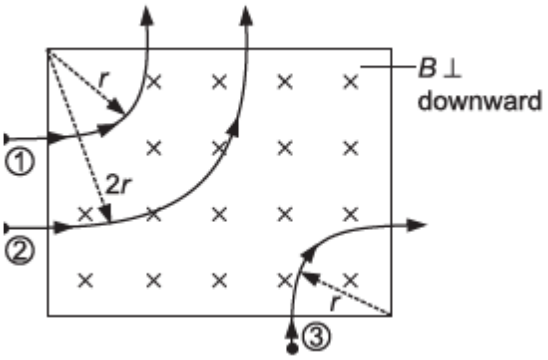


8 Two small identical circular coils marked 1 and 2 carry equal currents, are placed with their geometric axes perpendicular to each other as shown in the figure. Derive
an expression for the resultant magnetic field at O

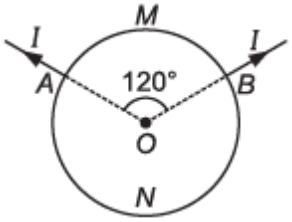


9 A beam of proton passes undeflected with a horizontal velocity v, through a region of electric and magnetic fields, mutually perpendicular to each other and perpendicular to the direction of the beam. If the magnitudes of the electric and magnetic fields are 100 kV/m, 50 mT respectively, calculate
(i) velocity of the beam v.
(ii) force exerted by the beam on a target on the screen, if the proton beam carries a current of 0.80 mA.

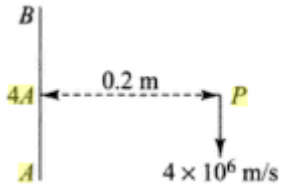
10 Three charged particles having equal momentum move horizontally and enter in a region at right angles to a uniform magnetic field and describe the circular paths, as shown in the figure .
If the magnetic field acts vertically downwards
(i) identify the type of charges on the particles
(ii) compare the magnitude of the charges on the particles.



11 A metal wire of uniform cross-section is bent in the form of a circular loop of radius R. A steady current 'I' is passed through the loop by connecting a battery between point A and B, as shown in the figure. Find the magnetic field at the centre of the loop.



12 A long straight wire AB carries a current of 4A. A proton P travels at 4×10^{6}m/s parallel to the wire 0.2m from it and in a direction opposite to the current as shown in the figure. Calculate the force which the magnetic field due to the current carrying wire exerts on the proton. Also specify its direction.



13 Briefly explain how a galvanometer is converted into a voltmeter. A galvanometer of a certain range is constructed by connecting a resistance of 980Ω in series with a galvanometer. When the resistance of 470 Ω is connected in series, the range gets halved. Find the resistance of the galvanometer.

14 Briefly explain how a galvanometer is converted into an ammeter. A galvanometer coil has a resistance of 15Ω and it shows full scale deflection for a current of 4mA. Converted it into an ammeter of range 0 to 6A.