Chapter 4
MOVING CHARGES AND MAGNETISM

Assignment-1

MCQ

1. An electron having energy 10eV is circulating in path having magnetic field 1.0×10^{-4} Tesla, the speed of the electron will be

   (a) $1.9 \times 10^{6} m/s$ (b) $3.8 \times 10^{6} m/s$ (c) $1.9 \times 10^{12} m/s$ (d) $3.8 \times 10^{12} m/s$

2. A proton passing from a fixed place with constant velocity. If E and B are electric and magnetic field respectively, then which statement is true?

   (a) $E \neq 0, B = 0$ (b) $B \neq 0, E = 0$ (c) $E \neq 0, B \neq 0$ (d) None of the above

3. A solenoid of 1.5 metre length and 4.0 cm diameter possesses 10 turns per cm. A current 5 amp is flowing through it. The magnetic field the axis inside the solenoid is

   (a) $2\pi \times 10^{-3} T$ (b) $2\pi \times 10^{6} T$ (c) $4\pi \times 10^{-3} T$ (d) $2\pi \times 10^{3} T$

4. A particle having charge 100 times that of a electron is revolving in a circular path of radius 0.8 m with one rotation per second. The magnetic field produced at the centre is

   (a) $10^{-7} \mu_0$ (b) $10^{-17} \mu_0$ (c) $10^{-6} \mu_0$ (d) $10^{-15} \mu_0$

5. Biot-Savart law indicates that the moving electrons (velocity v) produce a magnetic field B such that

   (a) B ⊥ v.

   (b) B || v.

   (c) it obeys inverse cube law.

   (d) it is along the line joining the electron and point of observation.

6. The coil of a moving coil galvanometer is wound over a metal frame in order to

   (a)Reduce hysteresis

   (a) Increase the sensitivity

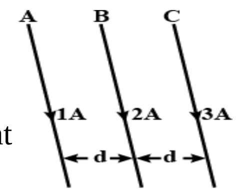
   (c)Increase moment of inertia

   (d) Provide electromagnetic damping

7. Two wires of same length are shaped into a square of side **'a'** and circle of radius **'r'**. If they carry same current, the ratio of the magnetic moment is

   (a)2: π (b) π: 2 (c) π: 4 (d) 4: π

8. Three infinitely long parallel straight current carrying wires A, B and C are kept equal distance from each other as shown in the figure given. The wire C experiences net force **F**. The net force on wire C, when the current in wire A is reversed will be



   (a) Zero (b) $\frac{F}{2}$ (c) F (d) 2F

9. The nature of parallel and anti-parallel currents are
a. Parallel current repels and anti-parallel current attract
b. Parallel current attracts and anti-parallel current repel
c. Both current attract
d. Both current repel.

10. Intensity of magnetic field due to the bar magnet at a point inside a hollow steel-box is
a. Less than outside b. Same as outside c. More than outside d. Zero

1 MARK QUESTIONS

11. Write the expression, in a vector form, for the Lorentz magnetic force $\vec{F}$ due to a charge moving with velocity $\vec{v}$ in a magnetic field $\vec{B}$. What is the direction of the magnetic force?
12. What is figure of merit of a galvanometer?
13. In a certain arrangement, a proton does not get deflected while passing through a magnetic field region. State the condition under which it is possible.
14. Using the concept of force between two infinitely long parallel current carrying conductors, define one ampere of current. (All India 2014)
15. Write the expression, in a vector form, for the Lorentz magnetic force $\vec{F}$ due to a charge moving with a velocity $\vec{v}$ in a magnetic field $\vec{B}$. What is the direction of the magnetic force?
16. Why should be the spring/suspension wire in a moving coil galvanometer have low torsional constant?
17. What is the underlying principle of a moving coil galvanometer?

18. A coil of area A carrying a steady current I has a magnetic moment $\vec{m}$ associated with it. Write the relation between $\vec{m}$, I and A in vector form.

2 MARK QUESTIONS

19. A current carrying loop is free to turn in a uniform magnetic field B. Under what conditions, will the torque acting on it be (i) minimum and (ii) maximum?
20. A current carrying loop is free to turn in a uniform magnetic field B. Under what conditions, will the torque acting on it be (i) minimum and (ii) maximum?
21. A steady current (I_1) flows through a long straight wire. Another wire carrying steady current (I_2) in the same direction is kept close and parallel to the first wire. Show with the help of a diagram how the magnetic field due to current (I_1) exerts a magnetic force on the second wire. Write expression for this force.
22. A moving coil galvanometer, whose coil resistance is 100 **Ω**, shows full scale deflection when 1mV is put across it. How can it be converted into a voltmeter of range (0-1V)?
23. How do convert a galvanometer into an ammeter? Why is an ammeter always connected in series?
24. What is the behaviour of magnetic field lines due to diamagnetic material?

2 MARKS QUESTIONS

25. A long straight wire in the horizontal plane carries a current of 50 A in north to south direction. Give the magnitude and direction of B at a point 2.5 m east of the wire.
26. Write the expression for Lorentz magnetic force on the particle of charge q moving with velocity v in a magnetic field B. Show that no work is done by this force on the charged particle.
27. Derive the expression for the torque τ acting on a rectangular current loop of area A placed in a uniform magnetic field B. Show that $\vec{\tau} = \vec{m} \times \vec{B}$ where $\vec{m}$ is the magnetic moment of the current loop given by $\vec{m} = I\vec{A}$.
28. Describe the working principle of a moving coil galvanometer. Why is it necessary to use **(i)** a radial magnetic field and **(ii)** a cylindrical soft iron core in a galvanometer? Write the expression for current sensitivity of the galvanometer. Can a galvanometer as such be used for measuring the current? Explain.

5-MARKS QUESTIONS

29. (i)Explain using a labelled diagram the principle and working of a moving coil galvanometer. What is the function of (a) uniform radial magnetic field (b) soft iron core?

(ii) Define the terms (a) Current sensitivity (b) Voltage sensitivity

(iii) Explain why does increasing the current sensitivity not necessarily increases the voltage sensitivity

Assertion-Reason

Select the correct answer to these questions from the codes (a), (b), (c) and (d) are as given below

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false and R is also false.

30. **Assertion** Difference between an electric line and magnetic line of force is that electric lines of force are discontinuous and the magnetic field lines are continuous.

Reason Electric lines of forces do not exist inside a charged conductor but magnetic lines exist inside a magnet.

31. **Assertion** A current carrying solenoid behaves like a bar magnet.

Reason The circular loop in which the direction of current is clockwise behaves like the South Pole and the one having anticlockwise current behaves like the North Pole.

32. **Assertion** Permanent magnets retain their ferromagnetic property for a long period of time.

Reason Steel is a diamagnetic material.

33. **Assertion** When a bar magnet is hung freely it points toward geographical poles.

Reason Magnetic field lines do not intersect.

34. **Assertion** A diamagnetic specimen would move towards the weaker region of the field.

Reason A diamagnetic specimen is repelled by a magnet.

35. **Assertion** Motion of electron around a positively charged nucleus is different from the motion of a planet around the sun.

Reason The force acting in both the cases is same in nature.

36. **Assertion** Two parallel conducting wires carrying currents in same direction, come close to each other.

Reason Parallel currents attract and anti-parallel currents repel.

37. **Assertion** A galvanometer cannot as such be used as an ammeter to measure the current across a given section of the circuit.

Reason For this it must be connected in series with the circuit.

38. **Assertion** Magnetic lines of force form continuous closed loops whereas electric lines of force do not.

Reason Magnetic poles always occur in pairs as north pole and south pole.

39. **Assertion** An electron moving along the direction of magnetic field experiences no force.

Reason The force on electron moving along the direction of magnetic field is $F = qVB \sin 0° = qVB$

40. **Assertion** Iron is not a magnet.

Reason Iron is diamagnetic substance

Case study based question

41. Force on a moving charge

Stationary charge creates an electric field but a moving charge creates a magnetic field also that can affect other moving charges. It was observed by Oersted. He saw that if a magnetic needle is placed near current carrying wire it shows slight deflection. The direction of the magnetic field can be determined by using the right hand thumb rule. Magnetic field is the space around a magnet, a current carrying conductor up to which it can attract or repel magnetic material. Force on a moving charge in magnetic field is given by the formula

$$\vec{F} = q(\vec{v} \times \vec{B})$$

Where q = charge on particle

v = velocity of charge particle

B = magnetic field and

F = magnetic force

When a current carrying conductor is placed in an external magnetic field, it experiences a mechanical force. A conductor of length 1 carrying current I held in a magnetic field B at an angle θ with it, experiences a force given by $F = I\, l\, B \sin\theta$.

1. Moving charge can create

(a) Electric field (b) magnetic field

(c) Both electric and magnetic field (d) none of them

2. If a current is flowing from south to north in a straight wire what will be the direction ofmagnetic field to its left side

(a) Outward (b) inward

(c) Towards right (d) towards left

3. Which of the following cannot be the source of magnetic field?

(a) Current carrying wire (b) moving electron

(c) Moving proton (d) stationary charge

4. Force acting on a conductor of length 10 m carrying a current of 6A kept perpendicular tothe magnetic field of 2T is

(a) 60N (b) 120N (c) 90N (d) 100N

5. A straight wire is of mass 100 g and length 1.0 m carrying a current of 5A. It is suspendedin a uniform horizontal magnetic field **B**. The magnitude of **B** is (assume that g = 9.8ms")

(a) 0.196T (b) 0.46T (c) 0.15T (d) 3.26T