CHAPTER-4
MOVING CHARGES AND MAGNETISM

One mark questions:

1. What was the conclusion made by Oersted when a magnetic compass needle is brought near a current carrying straight wire? (U)
2. Who investigated the phenomena that "moving charges or currents produce a magnetic field around its space". (U)
3. Name the scientist who unified both the electricity and magnetism. (K)
4. Write the expression for the magnetic force acting on a charged particle moving in a uniform magnetic field. (U)
5. Write the expression for the magnetic force acting on a charged particle moving in a uniform magnetic field in vector form. (U)
6. What is the value of magnetic force when a charged particle moves parallel to the direction of magnetic field? (U)
7. How many tesla makes one gauss? (U)
8. What should be the angle between the velocity vector of the charged particle and the magnetic field to experience a maximum force, when a charged particle is moving in a uniform magnetic field? (U)
9. What is the magnitude of the force experienced by a charged particle if it moves along the direction of the magnetic field? (U)
10. An alpha particle and a proton are projected with same velocity v perpendicular to the direction of the magnetic field B. which particle experiences maximum force? (U)
11. An alpha particle is moving along positive X- axis with a velocity v. What is the direction of the magnetic force on it, when magnetic field is directed along positive Y-axis? (U)
12. A proton is projected along +X-axis, experiences a force due to magnetic field along +Y-axis. What is the direction of the magnetic field? (U)
13. Does a neutron moving in a magnetic field experience a force? (K)
14. What is the magnitude of force experienced by a stationary proton in a magnetic field? (K)
15. Mention the rule used to find the direction force on a charged particle moving in a magnetic field. (K)
16. State Fleming's left hand rule. (K)
17. Define S.I unit of magnetic field in terms of force acting on a charged particle in a magnetic field. (U)
18. What is Lorentz force? (U)
19. Write the expression for Lorentz force. (U)
20. Write the expression for Lorentz force acting on a charged particle in the vector form. (U)
21. A proton enters a magnetic field at 30^0. At what angle should it enter to experience double the force? (A)
22. What happens to a current carrying conductor if it is placed in a magnetic field? (U)

23. Write an expression for the force acting on a current carrying conductor in a magnetic field. (U)
24. A current carrying conductor placed perpendicular to the direction of the magnetic field. What is the direction of force acting on it? (U)
25. When is the mechanical force acting on a current carrying conductor placed in magnetic field is zero? (K)
26. Which rule gives the direction of the magnetic force acting on current carrying conductor kept in a magnetic field? (K)
27. What will be the path of a charged particle in a uniform magnetic field, when it is moving parallel to the field direction? (K)
28. What will be the path of a charged particle in a uniform magnetic field, when it is moving perpendicular to the field direction? (K)
29. What is the nature of trajectory of a charged particle in uniform magnetic field when it enters the field making an angle θ with the field? (K)
30. A proton and an alpha particle enter the region of uniform magnetic field at right angles to the direction of the field with same velocity. Which particle describes greater circular path? (K)
31. A proton and an electron having the same momentum enters a uniform magnetic field at right angles to the direction of the field. Which particle describe smaller circular path? (K)
32. A charged particle moves through a magnetic field. Is the momentum of the particle affected? (K)
33. How does the frequency of revolution of a charged particle in a magnetic field depends on its charge? (U)
34. How does the frequency of revolution of a charged particle in a magnetic field depends on its mass? (U)
35. How does the frequency of revolution of a charged particle in a magnetic field depends on its velocity? (U)
36. Write the expression for the velocity of a charged particle in terms of crossed electric and magnetic fields to move without deviation. (U)
37. What is the magnitude of the force experienced by a charged particle in a crossed electric and magnetic fields when it proceeds without deviation? (K)
38. What is a cyclotron? (K)
39. On what principle a cyclotron works? (U)
40. Write the expression for the frequency of cyclotron. (K)
41. Mention any one use of cyclotron. (K)
42. What is a mass spectrometer? (K)
43. What is the principle of mass spectrometer? (U)
44. Give the vector form of Biot-Savart's law. (U)
45. What is the direction of the magnetic field due to a current element? (K)
46. Write the S.I unit of current element? (K)
47. Write the S.I unit for permeability of free space. (K)

48. What is the value of $\left(\frac{\mu_0}{4\pi}\right)$ in S.I system? (K)
49. Name the rule to find the direction of a magnet field due to a circular current loop. (K)
50. State right hand thumb rule. (K)
51. Write the expression for magnet field at the center of circular current loop. (U)
52. What is the direction of magnetic field at the center of a current carrying circular coil, when current is flowing in clockwise direction? (K)
53. How does the magnetic field at the center of circular current loop depend on its radius? (U)
54. How does the magnetic field at center of circular current loop depend on number of turns of the coil? (U)
55. What happens to the magnetic field at the center of the current loop when the current through it is doubled? (U)
56. Graphically show the variation of magnetic field with distance from the center of a wire carrying current. (S)
57. If the magnitude of the current through the circular coil is halved, then what is the magnitude of magnetic field at its center? (U)
58. State Ampere's circuital law. (K)
59. Write the expression for magnetic field at a point due to long straight current carrying conductor. (K)
60. What is a solenoid? (K)
61. What is meant by an ideal solenoid? (K)
62. Write the expression for the magnetic field at a point inside current carrying solenoid. (K)
63. What is a toroid? (K)
64. Write the expression for the magnetic field at a point inside the air cored toroid. (U)
65. What is the magnitude of magnetic field at a point in the open space inside the toroid? (K)
66. What is the magnitude of magnetic field at a point outside the toroid?(K)
67. Write the expression for the force between two long straight parallel conductors carrying currents. (U)
68. What is the nature of force between two parallel conductors carrying currents in the same direction?(K)
69. What is the nature of force between two parallel conductors carrying currents in the opposite direction?(K)
70. When do the two parallel conductors carrying currents attract each other? (K)
71. Two parallel long conductors carry currents in the same direction experience a force F. If the direction of the current in one is reversed, then what is the force experienced by them? (U)
72. Two parallel beams of electrons travelling in the same direction, separated by a certain finite distance. What is the nature of force between them? (U)
73. Define magnetic moment of a current loop. (U)
74. Write the expression for the torque exerted by a current loop kept in a uniform magnetic field. (U)
75. Give the S.I unit of magnetic dipole moment. (K)
76. Write the expression for the magnetic dipole moment of a current loop in vector form. (U)

77. Is magnetic dipole moment a vector or a scalar quantity? (K)
78. How magnetic dipole moment does depend on strength of the magnetic field? (K)
79. Current in a loop is flowing in clockwise direction. This face of the loop behaves as which magnetic pole? (K)
80. Current in a loop is flowing in anticlockwise direction. This face of the loop behaves as which magnetic pole? (K)
81. What happens to the current loop when it is placed in a uniform magnetic field? (K)
82. Write the expression for the magnitude of the torque on a current loop in a uniform magnetic field. (K)
83. Write the expression for torque on a current loop in a uniform magnetic field in vector form. (U)
84. What is the direction of torque on a current loop placed in a uniform magnetic field? (U)
85. A current carrying loop does not tend to rotate in a uniform magnetic field. What do you conclude from this statement? (U)
86. Write the expression for magnetic dipole moment of revolving electron in hydrogen atom. (K)
87. Define gyromagnetic ratio of the electron. (U)
88. Write the S.I unit of gyromagnetic ratio. (K)
89. Give the numerical value of gyromagnetic ratio of the electron. (K)
90. Define Bohr magneton. (U)
91. Write an expression for Bohr magneton. (U)
92. Give the S.I unit of Bohr magneton. (K)
93. Write the value of Bohr magneton. (K)
94. Mention the principle on which a moving coil galvanometer works. (K)
95. How current is measured in a moving coil galvanometer? (K)
96. When the galvanometer is said to be sensitive? (K)
97. Define current sensitivity of a moving coil galvanometer. (U)
98. Define voltage sensitivity of a moving coil galvanometer. (U)
99. Give the S.I unit of current sensitivity. (K)
100. Give the S.I unit of voltage sensitivity. (K)
101. What is an ammeter? (K)
102. How do you convert a galvanometer into an ammeter? (K)
103. What should be the resistance of an ideal ammeter? (U)
104. How do you increase the range of an ammeter? (U)
105. Which of the following has lower resistance (a) an ammeter or (b) a miliammeter? (K)
106. What is a voltmeter? (K)
107. How do you convert a galvanometer into a voltmeter? (K)
108. What should be the resistance of an ideal voltmeter? (U)
109. Which of the following has high resistance (a) a voltmeter or (b) a milivoltmeter? (K)

Two mark questions:

1. Write the expression for magnetic force acting on a charged particle moving in a uniform magnetic field and explain the terms. (K)

2. Represent the direction of the magnetic field (i) into the plane of the paper (ii) emerging out of the plane of the paper. (S)
3. Write the S.I unit of magnetic field and also its dimensions. (U)
4. Find the magnitude and direction of the force on 3nC of charge moving in a magnetic field of strength 0.002T with a speed $4X10^5$ ms^{-1} at perpendicular to the field. (A)
5. When is the force on a charged particle moving in a magnetic field (a) maximum and (b) minimum? (K)
6. Does a moving charge always experience a force in a magnetic field? Explain. (U)
7. A proton and an electron enter a magnetic field at the same angle and with the same speed. Do they experience the same force? Justify your answer. (U)
8. What is Lorentz force? Write the expression representing this force. (K)
9. Find the magnitude of the force experienced by an electron moving with a velocity $0.5X10^7 ms^{-1}$ in a magnetic field of strength $0.5X10^{-2}T$ making an angle 30^0 with the magnetic field. (A)
10. A proton and an electron moving with the same momentum enter a magnetic field at right angles to it. Compare the radii of their trajectory. (A)
11. Write the expression for the force acting on a current carrying conductor in a magnetic field and explain the terms.(K)
12. When is the force on a conductor carrying current in a magnetic field (a) maximum and (b) minimum? (K)
13. Write the expression for radius of circular path described by a charged particle in a uniform magnetic field and explain the terms. (K)
14. Arrive at the relation between speed of light, permeability of free space and permittivity of free space. (U)
15. A 10 μC charge moving with a velocity of 2×10^5 ms^{-1} enters a uniform magnetic field of 2 T, along the direction parallel to the field. Find the radius of its path. (A)
16. Write the expression for angular frequency of a charged particle moving in a uniform transverse magnetic field and explain the terms. (U)
17. Write the expression for the pitch of the helical path traced by an electron in a uniform magnetic field and explain the terms. (K)
18. What is meant by velocity selector? Give its importance. (U)
19. On what principle a cyclotron works? Explain. (U)
20. What are the functions of electric and magnetic fields in a cyclotron? (U)
21. Draw neat labeled diagram of cyclotron. (S)
22. Mention two places where cyclotron is used. (K)
23. Write the expression for cyclotron frequency and explain the terms. (K)
24. Write the expression for maximum kinetic energy acquired by the charged particles accelerated by a cyclotron and explain the terms. (K)
25. Give the vector form of Biot-Savart's law and explain the terms. (U)
26. Write the expression for magnetic field at a point due to current element and explain the terms. (K)
27. When is the magnetic field at a point due to a current element (1) maximum and (2) minimum? (K)

28. Write the expression for the magnet field produced at a point on the axis of circular current loop and explain the terms. (U)
29. How will magnetic field strength at the center of the circular current loop change, if the current through the coil is halved and radius of the loop is doubled? (A)
30. State and explain Ampere's circuital law. (K)
31. Write the expression for magnetic field at a point due to long straight current carrying conductor and explain the terms. (K)
32. How does the magnetic field at a point due to straight long current carrying conductor vary with the
    (a) strength of the current and
    (b) Perpendicular distance of the point from the conductor. (U)
33. Write an expression for magnetic field at a point inside current carrying solenoid and explain the terms. (U)
34. Mention the factors on which the magnetic fields at a point inside a solenoid depend. (U)
35. How does the magnetic field at a point inside an air cored solenoid vary with the (i) number turns per unit length and (ii) strength of a current though the solenoid. (U)
36. Write the expression for the magnetic field at a point inside the air cored toroid and explain the terms. (K)
37. Write the expression for the force between two long straight parallel conductors carrying currents and explain the terms. (K)
38. What is the nature of the force between two parallel conductors carrying currents in the (a) same direction and (b) opposite direction? (K)
39. Define 'ampere' the S.I unit of current by writing the expression for force between two parallel currents. (U)
40. How does the force between the conductors carrying currents vary with (a) strength of current in the conductor and (b) the distance between the conductors? (U)
41. When is the torque on a current loop in magnetic field (i) maximum and (ii) minimum (K)
42. Define gyromagnetic ratio of an electron. Mention its value. (U)
43. Write an expression for angular deflection produced by a coil in moving coil galvanometer and explain the terms. (K)
44. Draw a neat labeled diagram of moving coil galvanometer. (S)
45. What is the significance of radial magnetic field in a moving coil galvanometer? (U)
46. What is the role of soft iron cylinder inside the coil in a moving coil galvanometer? (U)
47. Why an ammeter is always connected in series with a circuit? (U)
48. Why should an ammeter have low resistance? (U)
49. Why a voltmeter is always connected in parallel with a circuit? (U)
50. Why should a voltmeter have high resistance? (U)

Three mark questions:

1. Describe Oersted's experiment. (K)
2. On what factors the force experienced by a charged particle moving in a magnetic field depends? (K)

3. On what factors Lorentz force depends? (K)
4. Write the three features observed at the interaction of a charged particle in the presence of both the electric field and the magnetic field. (U)
5. Arrive at the expression for the velocity selector by stating the condition, when a charged particle is moving in combined electric and magnetic field. (U)
6. Mention the places where cyclotron is used. (K)
7. Derive the expression for the force acting on a conductor carrying current in a uniform magnetic field. (U)
8. Obtain the expression for radius of circular path described by a charged particle in a uniform magnetic field. (U)
9. Obtain the expression for time period of revolution of a charged particle in a uniform transverse magnetic field. (U)
10. Obtain the expression for the maximum kinetic energy acquired by a charged particle accelerated by a cyclotron. (U)
11. Give the theory of cyclotron. (or) Obtain an expression for cyclotron frequency. (U)
12. State and explain of Biot-Savart's law. (U)
13. Assuming the expression for the magnetic field at a point on the axis of a circular current loop, obtain the expression for the magnetic field at the center of the loop. (U)
14. Derive the expression for the magnetic field due to a straight infinite current carrying wire using Ampere's circuit law. (U)
15. Derive the expression for the magnetic field at a point inside a solenoid carrying current. (U)
16. Explain how a circular current loop behaves as a magnetic dipole. (U)
17. Assuming the expression for magnetic dipole moment of a revolving electron in a hydrogen atom, obtain the expression for Bohr magneton. (U)
18. Derive the expression for magnetic dipole moment of a revolving electron. (U)
19. Explain how to convert a galvanometer into an ammeter. (U)
20. Explain how to convert a galvanometer into a voltmeter. (U)
21. Write any three factors on which the current sensitivity of a moving coil galvanometer depends. (U)
22. Write any three factors on which the voltage sensitivity of a moving coil galvanometer depends. (U)
23. How do you increase the current sensitivity of moving coil galvanometer? (U)
24. How do you increase the voltage sensitivity of moving coil galvanometer? (U)
25. Does the increase in current sensitivity increase voltage sensitivity? Explain (U)
26. Give any three comparative differences between Biot-Savart's law for magnetic field and Coulomb's law for electrostatic field. (U)

Five mark questions:

1. With a neat labeled diagram, explain the construction and working of a cyclotron. (S)
2. What is the principle of cyclotron? Arrive at the expression for the cyclotron frequency and the kinetic energy of the ions. (U)
3. Derive the expression for magnetic field at a point on the axis of a circular current loop. (U)
4. What is a toroid? Derive the expression for the magnetic field due to a toroid. (U)
5. Derive the expression for the force between two long straight parallel conductors carrying currents and hence define ampere, the S.I. unit of current. (U)
6. Obtain the expression for the torque acting on a rectangular current loop placed in a uniform magnetic field?(U)
7. Derive the expression for magnetic dipole moment of a revolving electron in a hydrogen atom.(U)
8. With neat labeled diagram, explain the working of a moving coil galvanometer.{OR} Give the theory of moving coil galvanometer. (U)

Numerical problems

1. A current of 1A is flowing through a circular loop of 100mm radius. Find the magnetic field at a point which is at a distance of 100mm from the center of this loop on its axis due to this current loop. Also calculate the magnetic field at the center of this loop.(A) **[$2.22X10^{-6}$T, $6.3X10^{-6}$T]**
2. A magnetic field of $35.34X10^{-6}$T is applied on an electron in a direction perpendicular to its motion. Find the time required for the electron to complete one revolution, also find the speed with which the electron moves if the radius of the path is 2mm. Given mass of the electron = $9.1X10^{-31}$Kg, and charge= $1.6X10^{-19}$C. (A) **{period=$1X10^{-6}$s and speed = $12.42X10^{3}ms^{-1}$}**
3. Two straight parallel conductors of 2m length are 0.2m apart. Find the magnitude of the force acting on the conductors if a current of 3A flows through each of them. Also find the force per unit length of the conductor. (A) **[$18X10^{-6}$N, $9X10^{-6}$N]**
4. A miliammeter of resistance 0.5Ω gives full scale deflection for a current of 5mA. How to convert it into an ammeter of range (0-0.5A) and a voltmeter of range (0-50V). (A)
5. A rectangular coil of length 0.06m and breadth 0.03m, having 100 turns is placed in a uniform magnetic field of strength 0.5T such that its plane is parallel to the field. If 5mA of current is flowing through the coil, find the force on each side of the coil and also the torque exerted by it. (A) **[$1.5X10^{-2}$N, $4.5X10^{-4}$Nm]**

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