Chapter 10. Magnetic Field Due to Electric Current

MCQ'S (1 Mark Each)

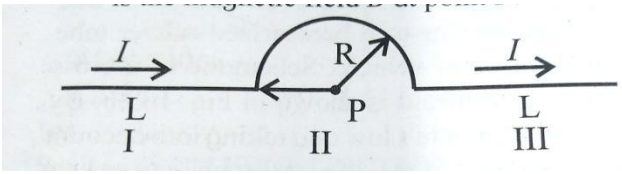
1) According to right hand rule, the direction of magnetic induction if the current is directed in anticlockwise direction is

(a) perpendicular and inwards (b) perpendicular and outwards

(c) same as current (d) opposite to that of current

Ans: b) perpendicular and outwards

2) A conductor has three segments; two straights of length L and a semicircular with radius R. It carries a current I What is the magnetic field B at point P?



(a) $\frac{\mu_0 I}{4\pi R}$ (b) $\frac{\mu_0}{4\pi}\frac{I}{R^2}$ (c) $\frac{\mu_0 I}{4R}$ (d) $\frac{\mu_0 I}{4\pi}$

Ans: a) $\frac{\mu_0 I}{4\pi R}$

3) A strong magnetic field is applied on a stationary electron. Then the electron

(a) moves in the direction of the field (b) remained stationary

(c) moves perpendicular to the direction of the field (d) moves opposite to the direction of the field

Ans: b) remained stationary.

4) The force between two parallel current carrying conductors is F. If the current in each conductor is doubled, then the force between them becomes

(a) 4F (b) 2F (c) F (d) F/4

Ans: a) 4F

5) Which of the following is not a unit of magnetic induction?

(a) gauss (b) tesla (c) oersted (d) Wb/m^2

Ans.: c) oersted

6) The magnetic dipole moment of current loop is independent of

(a) number of turns (b) area of loop

(c) current in the loop (d) magnetic field in which it is lying

Ans: d) magnetic field in which it is lying

7) Circular loop of radius 0.0157 m carries a current 2 A. The magnetic field at the centre of the loop is

(a) 1.57×10^{-3} Wb/m² (b) 8.0×10^{-5} Wb/m² (c) 2.0×10^{-3} Wb/m² (d) 3.14×10^{-1} Wb/m²

Ans: (b) 8.0×10^{-5} Wb/m²

Very Short Answer (VSA) (1 MARK Each)

1) What is Lorentz force?

2) What is Solenoid?

3) What is Toroid?

4) Calculate the value of magnetic field at a distance of 2 cm from a very long straight wire carrying a current 5 A

5) What happens to the magnetic field at the centre of a circular current carrying coil if we double the radius of the coil keeping the current unchanged?

6) A solenoid of length 50 cm of inner radius of 1 cm and is made up of 500 turns of copper wire for a current of 5 A in it. What will be magnitude of magnetic field inside the solenoid?

7) State the orientation of magnetic dipole with respect to magnetic field, which possess maximum magnetic potential energy

Short Answer I (SA1) (2 MARKS Each)

1) A toroid of 4000 turns has outer radius of 26 cm and inner radius of 25 cm. If the current in the wire is 10 A. Calculate the magnetic field of the toroid. [Ans: 3.137×10^{-2} T]

2) Magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid Why?

3) A solenoid of length π m and 5 cm in diameter has winding of 1000 turns and carries a current of 5 A. Calculate the magnetic field at its centre along the radius. **[Ans : 2 x 10^{-3} T]**

4) Currents of equal magnitude pass through two long parallel wires having separation of 1.35 cm. If the force per unit length on each wire is 4.76 x 10^{-2} N/m, what is *I* ? **[Ans: 56.68 A]**

5) Explain " Magnetic force never does any work on moving charges".

6) State the conditions when magnetic potential energy of a magnetic dipole (current carrying coil) kept in uniform magnetic field be minimum and maximum.

7) Derive the expression for magnetic field produced by a current in a circular arc of wire.

8) Explain the condition under which a charged particle will travel through a uniform magnetic field in a helical path.

9) What is a cyclotron? State its principle of working.

10) What are the factors on which the cyclotron frequency depends?

Short Answer II (SA2) (3 MARKS Each)

1) Explain Construction and working of Moving coil Galvanometer.
2) Explain Biot Savart's Law.
3) Explain cyclotron motion and cyclotron formula.
4) State under what conditions will a charged particle moving through a uniform magnetic field travel in 1) a straight line 2) a circular path 3) a helical path.
5) A Rectangular coil of 10 turns, each of area 0.05 m^2, is suspended freely in a uniform magnetic field of induction 0.01 T. A current of 30 μA is passed through it. (i) What is the magnetic moment of the coil (ii) What is the maximum torque experienced by the coil? ***[Ans: 15 μA.m^2, 1.5 x10^{-7} N.m]***
6) Using Ampere's Law, derive an expression for the magnetic induction inside an ideal solenoid carrying a steady current.
7) Derive an expression for the net torque on a rectangular current carrying loop placed in a uniform magnetic field with its rotational axis perpendicular to the field.
8) A circular loop of radius 9.7 cm carries a current 2.3 A. Obtain the magnitude of the magnetic field (i) at the centre of the loop (ii) at a distance of 9.7 cm from the centre of the loop but on the axis. ***[Ans: 14.9 μT, 5.267 μT]***
9) The magnetic field at the centre of a circular loop of radius 12.3 cm is 6.4 x 10^{-6} T. What will be the magnetic moment of the loop? ***[Ans: 5.954 x 10^{-2} A m^2]***

Long Answer (LA) (4 marks Each)

1) Show that currents in two long, straight, parallel wires exert forces on each other. Derive the expression for the force per unit length on each conductor.
2) Using Biot Savarts law, obtain the expression for the magnetic induction near a straight infinitely long current carrying wire.
3) Derive an expression for axial magnetic field produced by current in a circular loop.