Chapter 4
MOVING CHARGES AND MAGNETISM

Assignment-3
MCQ

Q1. The magnetic force acting on a charged particle of charge $-2\mu C$ in a magnetic field of 2T acting in y direction, when the particle velocity is $(2\hat{i} + \hat{j}) \times 10^6 ms^{-1}$, is

(a) 4 N in z direction
(b) 8 N in y direction
(c) 8 N in z direction
(d) 8 N in $-z$ direction

Q2. Two long parallel wires carry currents i_1 and i_2 such that $i_1 > i_2$. When the currents are in the same direction, the magnetic field at a point midway between the wires is $6 \times 10^{-6}T$. If the direction of i_2 is reversed, the field become $3 \times 10^{-5}T$. The ratio of $\frac{i_1}{i_2}$ is

(a) $1/2$ (b) 2 (c) $2/3$ (d) $3/2$

Q3. A straight wire carrying current l is made in circular loop. If M is the magnetic moment associated with the loop, then the length of the wire is

(a) $\sqrt{\frac{4\pi M}{l}}$ (b) $\sqrt{\frac{2\pi M}{l}}$ (c) $\sqrt{\frac{\pi M}{l}}$ (d) $\sqrt{\frac{\pi M}{2l}}$

Q4. Two similar coils of radius R are lying concentrically with their planes at right angles each other. The currents flowing in them are I and 2I, respectively. The resultant magnetic field induction at the centre will be

(a) $\frac{\sqrt{5}\mu_0 l}{2R}$ (b) $\frac{3\mu_0 l}{2R}$ (c) $\frac{\mu_0 l}{2R}$ (d) $\frac{\mu_0 l}{R}$

Q5. An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true?

(a) The electron will be accelerated along the axis.

(b) The electron path will be circular about the axis.

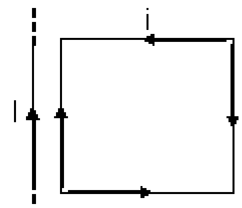
(c) The electron will experience a force at 45° to the axis and hence execute a helical-path.

(d) The electron will continue to move with uniform velocity along the axis of the solenoid.

Q6.In a certain region of space electric field $\vec{E}$ and magnetic field $\vec{B}$ are perpendicular to each other .An electron enters particularly to both fields and moves undeflected . The velocity of electron is

(a)E / B (b) B / E (c) $\vec{E}$ X $\vec{B}$ (d) $\vec{E} \cdot \vec{B}$

Q7. A rectangle loop carrying a current (i) is situated near a long straight wire such that the wire is parallel to the one of the sides of the loop and is in the plane of the loop. If a steady current i is established in wire as shown in the figure below, the loop will



(a) Rotate about an axis parallel to the wire (b) Move away from the wire or towards right

(c) Move towards the wire or towards left (d) Remain stationary

Q8. A wire in the form of a circular loop, of one turn carrying a current, produces magnetic field B at the centre. If the same wire is looped into a coil of two turns and carries the same current, the new value of magnetic induction at the Centre is

(a)B (b) 2B (c) 4B (d) 8B

Q9.When a magnetic dipole of moment $\vec{M}$ rotates freely about its axis from unstable equilibrium to stable equilibrium in a magnetic field $\vec{B}$, the rotational kinetic energy gained by it is :

(a)–M.B (b) $\frac{2}{M.B}$ (c) 2M.B (d) $\frac{M}{B}$

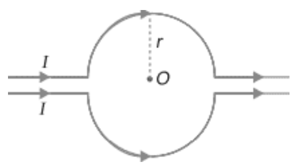
Q10.The current sensitivity of a galvanometer increases by 20%. If its resistance also increases by 20%, the voltage sensitivity will be

(a)Decrease by 1% (b) Increased by 10% (c) Increased by 5% (d)Decrease by 4%

1 MARK QUESTIONS

Q11. An electron, passing through a region is not deflected. Are you sure that there is no magnetic field in that region?

Q12.What is the value of magnetic field at point O due to current flowing in the wires?



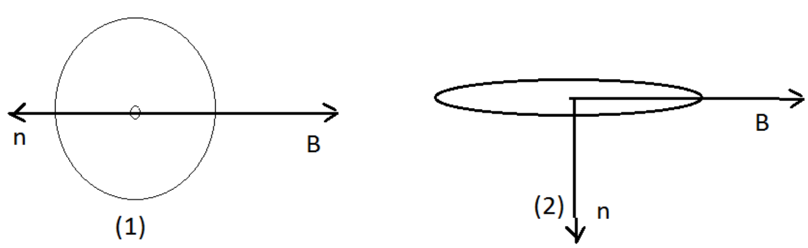
Q13. A long straight wire carries a steady current I along the Positive y-axis in a co-ordinate system. A particle of charge +Q is moving with a velocity $\vec{v}$ along the x-axis. In which direction will the particle experience a force?

2 MARK QUESTIONS

Q14. A wire AB is carrying a steady current of 6A and is lying on the table. Another wire CD carrying 4A is held directly above AB at a height of 1mm. 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 $g=10ms^{-2}$] [All India 2013]

Q15. A galvanometer of resistance 'G' can be converted into a voltmeter of range (0-V) volts by connecting a resistance 'R' in series with it. How much resistance will be required to change its range from 0 to v/2?

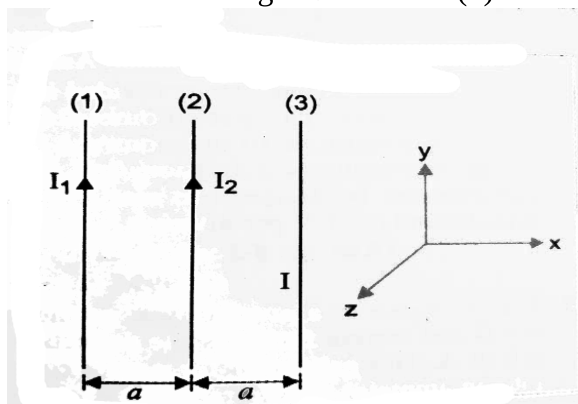
Q16. A current loop is placed in a uniform magnetic field in the following orientations (1) and (2). Calculate the magnetic moment in each case.



1.

2- MARKS QUESTIONS

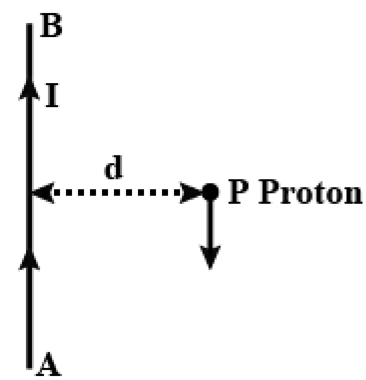
Q17. Three long straight parallel wires are kept as shown in the figure. The wire (3) carries a current I



(a) The direction of the flow of current I in the wire 3, is such that the net force on wire 1 due to the other two wires is zero

(b) By reversing the direction of current I , the net force on wire 2 due to the other two wires becomes zero. What will be the direction of the current I in the two cases? Also obtain the magnitudes of currents I_1, I_2 and I.

Q18. A long straight wire AB carries a current I. A proton P levels with a speed V, parallel to the wire at a distance d from it in a direction opposite to the current. What is the force experienced by the proton and what is its direction?



5-MARK QUESTIONS

Q19. (a) State the principle of working of a galvanometer

(b) A galvanometer of resistance G is converted into a voltmeter to measure upto V volts by connecting a resistance R1 in series with the coil. If a resistance R2 is connected in series with it then it can measure upto V/2 volts. Find the resistance, in terms of R1 and R2, required to be connected to convert it into a voltmeter that can read upto 2 V. Also find the resistance G of the galvanometer in terms of R1 and R2.

(c) **"**Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity." Justify the statement.

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.

20. **Assertion:** Steady current is the only source of magnetic field.

Reason: Only moving charge can create magnetic field.

21. **Assertion:** A magnetic field does not interact with a stationary charge.

Reason: A moving charge produces a magnetic field.

22. **Assertion:** When velocity of electron is perpendicular to B it will perform circular motion.

Reason: Magnetic force is perpendicular to velocity.

23. **Assertion:** A beam of electrons can pass undeflected through a region of E and B.

Reason: Force on moving charged particles due to magnetic field may be zero in some cases.

24. **Assertion:**If the path of a charged particle in a region of uniform electric and magnetic field is not a circle, then its kinetic energy will not remain constant.

Reason: In a combined electric and magnetic field region, a moving charge experiences a net force $F = qE + q(v \times B)$, where symbols have their usual meanings.

25. **Assertion:** If we increase the current sensitivity of a galvanometer by increasing the number of turns, its voltage sensitivity also increases.

Reason: Resistance of a wire also increases with N.

26. **Assertion:** When a magnetic dipole is placed in a non uniform magnetic field, only a torque acts on the dipole.

Reason: Force would not act on dipole if magnetic field were non uniform.

27. **Assertion:** Galvanometer can as such be used as an ammeter to measure the value of the current in given circuit

Reason: It gives a full-scale deflection for a current of the order of ampere.

28. **Assertion:** Diamagnetic materials can exhibit magnetism.

Reason Diamagnetic materials have permanent magnetic dipole moments.

29. **Assertion:** Paramagnetic materials can exhibit magnetism.

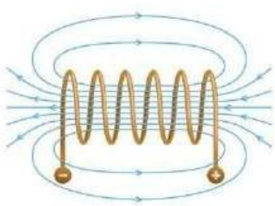
Reason: Paramagnetic materials have permanent magnetic dipole moments.

Case study based question

Q30.

Magnetic Field due to a Solenoid

Seema wound a very long insulated copper wire on a plastic pipe and carefully took the pipe out. The two ends of the copper wires are then attached to a battery. This cylindrical shape of copper wire is called a solenoid and this solenoid is used in several devices such as door bell, door locks, speakers etc. The magnetic field of a solenoid is given below



The magnetic field strength of a solenoid having n turns is **B** $=\mu_0 nI$, where, I is the current flowing in the solenoid, n is number of turns per unit length and μ_0 is the permeability of free space.

1. A long solenoid has 400 turns per meter and it is used as an electromagnet. If 1.5A current is flowing through it, what is the strength of the electromagnet

(a) 0.008 T (b) 0.4 T (c) 0.6 T (d) 0.007 T

2. Solenoid has length l, N turns and carrying a current I, what will be the magnetic field inside the solenoid

(a) μ_0 nlI (b) $\frac{\mu 0 \, N}{l}$ (c) $\mu 0$ nl^2 (d) None of these

3. The strength of magnetic field in a solenoid cannot be affected by

(a) Increasing its length (b) Decreasing the value of current

(c) Decreasing the number of turns (d) None of these

4. The strength of magnetic field outside a solenoid is

(a) Infinity (b) Zero

(c) Double the value of field inside

(d) Half the value of the field inside

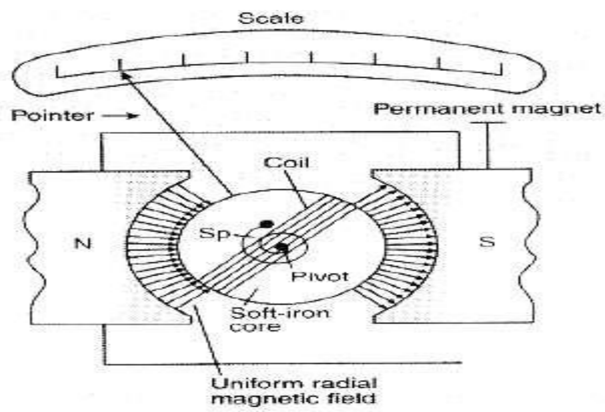
5. The nature of magnetic field lines passing through the current carrying solenoid is

(a) Closed loop

(b) Discontinuous curve

(c) Straight line

(d) None of these



SOURCE BASED QUESTION

Q31. Analog voltmeters and ammeters work by measuring the torque exerted by a magneticfield on a current carrying coil. The reading is displayed by means of the deflection of a pointer over a scale. The adjacent figure shows the essentials of a galvanometer, on which both Analogammeters and Analog voltmeters are based. Assume that the coil is 2.1 cm high, 1.2 cm wide has 250 turns and is mounted so that it can rotate about an axis (into the page) in a uniform radial magnetic field with B = 0.23 T. for any orientation of the coil, the net magnetic field through the coil is perpendicular to the normal vector of the coil (and thus parallel to the planeof coil) A spring SPSP provides a counter torque that balance the magnetic torque so that a given steady current I in the coil results in a steady angular deflection ϕ. The greater the currentis greater the deflection is and thus greater the torque required of the spring is

A current of 100 μ_A produces an angular deflection of 28°

1. What must be the torsional constant K of the spring?

(a) 2.6×10^{-8} Nm/degree (b) 5.2×10^{-8} Nm/degree

(c) 2.6×10^{-4} Nm/degree (d) 5.2×10^{-6} Nm/degree

2. If we reduce the value of this K to half of its value then the deflection would be(a) 28^0 (b) 56^0 (c) 14^0 (d) none

3. If the value of magnetic field is put equal to 0.69 T and $K=15.6\times10^{-8}$ $K=15.6\times10^{-8}$ Nm/degree. Then the deflection would be

(a) $<28^0$ (b) $=28^0$ (c) 14^0 (d) none