Moving Charges and Magnetism

Assertion & Reason Type Questions

Directions: In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

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

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

c. Assertion (A) is true but Reason (R) is false.

d. Both Assertion (A) and Reason (R) are false.

Q1. Assertion (A): If an electron is not deflected while passing through a certain region of space, then only possibility is that there is no magnetic region.

Reason (R): Force is inversely proportional to the magnetic field applied.

Answer : (d) In this case, we cannot be sure about the absence of the magnetic field because if the electron moving parallel to the direction of magnetic field, the angle between velocity and applied magnetic field is zero (F = 0). Then, also electron passes without deflection. Also, $F = eVB\sin\theta \Rightarrow F \propto B$.

Q2. Assertion (A): The magnetic field intensity at the centre of a circular coil carrying current changes, if the current through the coil is doubled.

Reason (R): The magnetic field intensity is dependent on current in conductor.

Answer : (a) The magnetic field at the centre of circular coil is given by,

$$B = \frac{\mu_0}{4\pi}\frac{2\pi nI}{a}$$

So, if current through coil is doubled, then magnetic field is B' = 2B. The magnetic field also gets doubled. The magnetic field is directly proportional to the current in conductor.

Q3. Assertion (A): Ampere's circuital law holds for steady currents which do not fluctuate with time.

Reason (R): Ampere's circuital law is similar to that of Biot-Savart's law.

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

Q4. Assertion (A): Magnetic field due to current carrying solenoid is independent of its length and cross-sectional area.

Reason (R): The magnetic field inside the solenoid is uniform.

Answer : (b) Magnetic field due to a solenoid having n number of turns per metre and carrying current / is B = $\mu_0 nI$ which is independent of the length and area of cross-section of the solenoid.

The magnetic field inside the solenoid is uniform.

Q5. Assertion (A): The magnetic field at the ends of a very long current carrying solenoid is half of that at the centre.

Reason (R): If the solenoid is sufficiently long, the field within it is uniform.

Answer : (b) The magnetic field of a solenoid is given by,

$$B = \frac{1}{2}\mu_0 nI[\cos\theta_1 - \cos\theta_2]$$

For a long current carrying solenoid, the magnetic field at the ends of a very long solenoid is given by,

$$B = \frac{1}{2}\mu_0 nI = \frac{1}{2} \times \text{Magnetic field at the centre}$$

$$[\because \theta_1 = 90°, \theta_2 = 180°]$$

Q6. Assertion (A): The deflecting torque on a current carrying loop is zero when its plane is perpendicular to the direction of magnetic field.

Reason (R): The deflecting torque acting on a loop of magnetic moment $\vec{m}$ in a magnetic field $\vec{B}$ is given by the dot product of $\vec{m}$ and $\vec{B}$.

(CBSE 2023)

Answer : (c) When a plane of loop is perpendicular to the direction of the magnetic field, the angle between the magnetic moment vector and the magnetic field vector is 90°. In this case, the vector product of the two vectors becomes maximum in magnitude and deflecting torque becomes maximum. However, the dot product of two vectors becomes zero.

Q7. Assertion (A): When current is represented by a straight line, the magnetic field will be circular.

Reason (R): According to Fleming's left hand rule, direction of force is parallel to the magnetic field.

Answer : (c) When current is straight, it means the current is passing through a straight conductor, the magnetic field produced due to current through a straight conductor is in the form of concentric circular magnetic lines of force whose centres lie on the linear conductor and are in a plane perpendicular to the plane of linear conductor. It means the magnetic field is circular.

Q8. Assertion (A): When radius of a circular loop carrying a steady current is doubled, its magnetic moment becomes four times.

Reason (R): The magnetic moment of a circular loop carrying a steady current is proportional to the area of the loop. **(CBSE 2023)**

Answer :

(b) Magnetic dipole moment of the current loop
= Ampere turns × Area of the coil
Initially, magnetic moment $M = I\pi r^2$
New magnetic moment $M' = I\pi(2r)^2 = 4I\pi r^2 = 4M$.
Thus, magnetic moment becomes four times when radius is doubled.

Q9. Assertion (A): On increasing the current sensitivity of a galvanometer by increasing the number of turns, may not necessarily increase its voltage sensitivity.

Reason (R): The resistance of the coil of galvanometer increases on increasing the number of turns.

Answer :

(a) When we increase current sensitivity by increasing number of turns, then resistance of coil also increases. So, increasing current sensitivity does not necessarily imply that voltage sensitivity will increase because

$$V_g = \frac{I_g}{R}$$

If I_g increase and R increase by different amounts, then V_g may increase or decrease.

Q10. Assertion: Cyclotron is a device which is used to accelerate the positive ion.

Reason: Cyclotron frequency depends upon the velocity.

Q11. Assertion: Cyclotron does not accelerate electron.

Reason: Mass of the electrons is very small.

Q12. Assertion: In electric circuits, wires carrying currents in opposite directions are often twisted together

Reason: If the wires are not twisted together, the combination of the wires forms a current loop, the magnetic field generated by the loop might affect adjacent circuits or components.

13. Assertion: The magnetic field produced by a current carrying solenoid is independent of its length and cross-sectional area.

Reason: The magnetic field inside the solenoid is uniform.

Q14. Assertion: A charge, whether stationary or in motion produces a magnetic field around it.

Reason: Moving charges produce only electric field in the surrounding space.

Q15. Assertion: A proton and an alpha particle having the same kinetic energy are moving in circular paths in a uniform magnetic field. The radii of their circular paths will be equal.

Reason: Any two charged particles having equal kinetic energies and entering a region of uniform magnetic field B in a direction perpendicular to B, will describe circular trajectories of equal radii.

Q16. Assertion: If the current in a solenoid is reversed in direction while keeping the same magnitude, the magnetic field energy stored in the solenoid remains unchanged.

Reason: Magnetic field energy density is proportional to the magnetic field.

Q17. Assertion: The magnetic field at the centre of the circular coil in the following figure due to the currents I1 and I2 is zero.

Reason: I1 = I2 implies that the fields due to the current I1 and I2 will be balanced.

Q18. Assertion: If the current in a solenoid is reversed in direction while keeping the same magnitude, the magnetic field energy stored in the solenoid decreases.

Reason: Magnetic field energy density is proportional to square of current.

Q19**. Assertion:** Free electrons always keep on moving in a conductor even then no magnetic force act on them in magnetic field unless a current is passed through it.

Reason: The average velocity of free electron is zero.

Q20**. Assertion:** To convert a galvanometer into an ammeter a small resistance is connected in parallel with it.

Reason: The small resistance increases the combined resistance of the combination.

ANSWER KEY 10 to 20

Q.1: (c)	**Q.2:** (c)	**Q.3:** (a)	**Q.4:** (b)
Q.5: (d)	**Q.6:** (c)	**Q.7:** (c)	**Q.8:** (d)
Q.9: (d)	**Q.10:** (b)	**Q.11:** (c)	