



Chapter 4 : Moving Charges and Magnetism (50 Important MCQs)

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Notes

50 important MCQs from GSEB, CBSE, NEET and JEE exams · Answer key at the end

Section A — Multiple Choice Questions

Each question carries 1 mark. Choose the correct option.

Q.1 An electron and a proton enter a uniform magnetic field normally with equal momentum. Then

- (A) the radii of curvature of both are equal (B) they do not get deflected
(C) the radius of the electron's path is larger (D) the radius of the proton's path is larger

Q.2 A particle of charge -16×10^{-18} C moving along +X with speed 10 m/s enters a region with a magnetic field $\vec{B}$ and an electric field of 10^4 V/m along -Z, both normal to its velocity. If the particle passes undeflected, the magnitude of B is

- (A) 10^3 Wb/m² (B) 10^5 Wb/m² (C) 10^{16} Wb/m² (D) 10^{-3} Wb/m²

Q.3 A charge Q of mass M moves on a circular path of radius R with velocity v perpendicular to a uniform magnetic field B. The work done by the field when the particle completes one revolution is

- (A) $QvBR$ (B) $QvB(2\pi R)$ (C) zero (D) $\frac{Mv^2}{R} \cdot 2\pi R$

Q.4 A uniform electric field and a uniform magnetic field point in the same direction. An electron is projected with its velocity in that same direction. Then

- (A) the electron will turn to its right (B) the electron will turn to its left
(C) the electron's speed will increase (D) the electron's speed will decrease

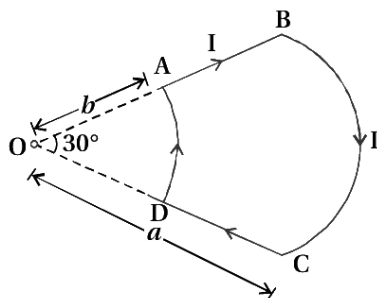
Q.5 In a region, steady and uniform electric and magnetic fields are parallel to each other. A charged particle is released from rest in the region. Its path will be a

- (A) circle (B) helix (C) ellipse (D) straight line

Q.6 A charged particle is moving in a uniform magnetic field. Then

- (A) its momentum changes but its kinetic energy does not change
(B) both its momentum and kinetic energy change
(C) neither its momentum nor its kinetic energy changes
(D) its kinetic energy changes but its momentum does not change

Q.7 Find the magnitude of the magnetic field at point O due to the current loop ABCD shown (arcs AD and BC are centred at O, OA = b, OC = a, angle at O = 30°).



(A) zero

(B) $\frac{\mu_0 I (b - a)}{24ab}$

(C) $\frac{\mu_0 I}{4\pi} \left[\frac{b - a}{ab} \right]$

(D) $\frac{\mu_0 I}{4\pi} \left[2(b - a) + \frac{\pi}{3}(a + b) \right]$

Q.8 In a region, the electric field is $\vec{E} = 3\hat{i} + \hat{j} + 2\hat{k}$ and the magnetic field is $\vec{B} = \hat{i} + \hat{j} - 3\hat{k}$. A charge q moves with velocity $3\hat{i} + 4\hat{j} + \hat{k}$. The y-component of the force acting on it is

(A) 2q

(B) 11q

(C) 5q

(D) 3q

Q.9 The electric field of a plane electromagnetic wave is $\vec{E}(t) = E_0 \frac{(\hat{i} + \hat{j})}{2} \cos(\omega t + kz)$. At $t = 0$ a positively charged particle is at the point $(0, 0, \pi/k)$. If its instantaneous velocity at $t = 0$ is $v_0 \hat{k}$, the force acting on it due to the wave is

(A) zero

(B) antiparallel to $\frac{\hat{i} + \hat{j}}{\sqrt{2}}$

(C) parallel to $\frac{\hat{i} + \hat{j}}{\sqrt{2}}$

(D) parallel to $\hat{k}$

Q.10 A proton of kinetic energy 1.0 MeV moving towards North enters a magnetic field directed along East. It accelerates with $a = 10^{12} \text{ m/s}^2$. The magnitude of the magnetic field is (take $m_p \approx 1.6 \times 10^{-27} \text{ kg}$)

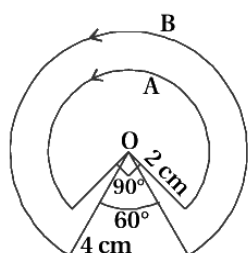
(A) 0.71 mT

(B) 7.1 mT

(C) 71 mT

(D) 710 mT

Q.11 Wire A, bent into a circular arc of radius 2 cm, carries 2 A; wire B, an arc of radius 4 cm, carries 3 A. They are placed as shown with common centre O (arc A leaves a gap of 90°, arc B a gap of 60°). The ratio of the magnetic fields due to A and B at O is



(A) 6 : 5

(B) 6 : 4

(C) 2 : 5

(D) 4 : 6

Q.12 Three particles — a proton (1), a deuteron (2) and an alpha particle (3) — have equal momentum. They are projected into a uniform magnetic field with velocity perpendicular to the field. The ratio of magnetic forces $F_1 : F_2 : F_3$ and the ratio of speeds $v_1 : v_2 : v_3$ are

(A) 2:1:1, 4:2:1

(B) 2:2:1, 4:2:1

(C) 4:2:1, 2:1:1

(D) 4:1:1, 2:2:1

Q.13 A long solenoid with a core of relative permeability μ_r has n turns per unit length and carries current I. Find B inside if $n = 1000 \text{ turns/m}$, $\mu_r = 500$, $\mu_0 = 4\pi \times 10^{-7} \text{ T m/A}$ and $I = 10 \text{ A}$.

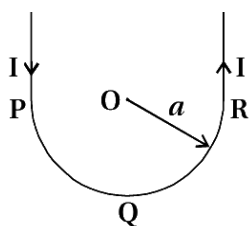
(A) 2π T

(B) 3π T

(C) 5π T

(D) 7π T

Q.14 The figure shows a U-shaped wire carrying current i as shown; the two long straight arms are parallel and PQR is a semicircle of radius a centred at the origin O. The magnetic field at O is ($\hat{k}$ points out of the page)



- (A) $\left(\frac{\mu_0 I}{2\pi a} + \frac{\mu_0 I}{4a}\right)\hat{k}$ (B) $\frac{\mu_0 I}{4a}\hat{k}$
 (C) $-\left(\frac{\mu_0 I}{2\pi a} + \frac{\mu_0 I}{4a}\right)\hat{k}$ (D) $-\frac{\mu_0 I}{4a}\hat{k}$

Q.15 A proton and an alpha particle with kinetic energies K_p and K_α enter a uniform magnetic field perpendicularly. The ratio of radii is $R_p : R_\alpha = 2 : 1$. Find $K_p : K_\alpha$.

- (A) 4 : 1 (B) 1 : 4 (C) 8 : 1 (D) 1 : 8

Q.16 Assertion (A): In a uniform magnetic field, the speed and energy of a moving charged particle remain the same.

Reason (R): A moving charged particle experiences a magnetic force perpendicular to its direction of motion.

- (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 but (R) is true.

Q.17 The magnetic field at the centre of a circular coil of radius r carrying current I is B . The field at a point on the axis at a distance $r/2$ from the centre is

- (A) $\frac{B}{2}$ (B) $2B$ (C) $\left(\frac{2}{\sqrt{5}}\right)^3 B$ (D) $\left(\frac{2}{\sqrt{3}}\right)^3 B$

Q.18 A proton, a deuteron and an α -particle with the same kinetic energy enter a uniform magnetic field at right angles to it. The ratio of the radii of their circular paths is

- (A) $1 : \sqrt{2} : \sqrt{2}$ (B) $1 : 1 : \sqrt{2}$ (C) $\sqrt{2} : 1 : 1$ (D) $1 : \sqrt{2} : 1$

Q.19 Two charged particles with the same kinetic energy pass through a uniform magnetic field perpendicular to their motion. The ratio of radii of their circular paths is $6 : 5$ and their masses are in the ratio $9 : 4$. The ratio of their charges is

- (A) 8 : 5 (B) 5 : 4 (C) 5 : 3 (D) 8 : 7

Q.20 The orbital magnetic moment of an electron (charge e , mass m) revolving around a nucleus with orbital angular momentum $\vec{l}$ is

- (A) $\vec{\mu}_L = \frac{e\vec{l}}{2m}$ (B) $\vec{\mu}_L = -\frac{e\vec{l}}{2m}$ (C) $\vec{\mu}_L = -\frac{e\vec{l}}{m}$ (D) $\vec{\mu}_L = \frac{e\vec{l}}{m}$

Q.21 A current in a circular coil of 2 turns produces magnetic induction B_1 at its centre. The coil is unwound and rewound into a circular coil of 5 turns, and the same current produces B_2 at its centre. The ratio B_2/B_1 is

- (A) $\frac{5}{2}$ (B) $\frac{25}{4}$ (C) $\frac{5}{4}$ (D) $\frac{25}{2}$

Q.22 An electron with energy 0.1 keV moves at right angles to the Earth's magnetic field of $1 \times 10^{-4} \text{ Wb m}^{-2}$. The frequency of revolution of the electron will be (mass of electron = $9.0 \times 10^{-31} \text{ kg}$)

- (A) $1.6 \times 10^5 \text{ Hz}$ (B) $5.6 \times 10^5 \text{ Hz}$ (C) $2.8 \times 10^6 \text{ Hz}$ (D) $1.8 \times 10^6 \text{ Hz}$

Q.23 A loop of radius a carrying current I is placed in the xy -plane with its centre at the origin. The magnetic field at the point $(0, 0, a)$ is

- (A) $\frac{\mu_0 I}{2\sqrt{2} a}$ (B) $\frac{\mu_0 I}{4\sqrt{2} a}$ (C) $\frac{2\mu_0 I}{a}$ (D) $\frac{\mu_0 I}{4a}$

Q.24 A current of 2 A flows around an equilateral triangle of side $4\sqrt{3} \text{ cm}$. The magnetic field at the centroid O of the triangle is

- (A) $4\sqrt{3} \times 10^{-4} \text{ T}$ (B) $4\sqrt{3} \times 10^{-5} \text{ T}$ (C) $\sqrt{3} \times 10^{-4} \text{ T}$ (D) $3\sqrt{3} \times 10^{-5} \text{ T}$

Q.25 Two infinite straight wires 20 cm apart carry current I in opposite directions. Point P lies midway between them (10 cm from each). The magnetic field (in SI units) at P is

- (A) $\frac{7\mu_0 I}{\pi}$ (B) $\frac{10\mu_0 I}{\pi}$ (C) $\frac{5\mu_0 I}{\pi}$ (D) $\frac{\mu_0 I}{\pi}$

Q.26 A proton with velocity $\vec{v}_0$ passes through a region with electric field E and magnetic field B . If the velocity of the proton does not change, which of the following may be true?

- (a) $E = 0, B = 0$ (b) $E = 0, B \neq 0$ (c) $E \neq 0, B = 0$ (d) $E \neq 0, B \neq 0$

- (A) a, b, c, d (B) a (C) a, b, d (D) a, b

Q.27 Two insulated circular loops A and B, each of radius a , carry current I in the anticlockwise direction. They are placed in mutually perpendicular planes with a common centre. The magnitude of the magnetic induction at the centre is

- (A) $\frac{\sqrt{2} \mu_0 I}{a}$ (B) $\frac{\mu_0 I}{2a}$ (C) $\frac{\mu_0 I}{\sqrt{2} a}$ (D) $\frac{2\mu_0 I}{a}$

Q.28 A current-carrying coil is placed in a uniform magnetic field. The coil will orient so that its plane becomes

- (A) inclined at 45° to the magnetic field (B) inclined at any arbitrary angle to the field
(C) parallel to the magnetic field (D) perpendicular to the magnetic field

Q.29 A uniform magnetic field acts at right angles to the direction of motion of electrons, which move in a circular path of radius 2 cm. If the speed of the electrons is doubled, the radius of the path becomes

- (A) 2.0 cm (B) 0.5 cm (C) 4.0 cm (D) 1.0 cm

Q.30 A galvanometer of resistance 50Ω has 25 divisions. A current of $4 \times 10^{-4} \text{ A}$ gives a deflection of one division. To convert it into a voltmeter of range 25 V, it should be connected with a resistance of

- (A) 2450Ω in series (B) 2500Ω in series (C) 245Ω in series (D) 2550Ω in series

Q.31 In an ammeter, 0.2% of the main current passes through the galvanometer. If the resistance of the galvanometer is G , the resistance of the ammeter will be

- (A) $\frac{1}{499}G$ (B) $\frac{499}{500}G$ (C) $\frac{1}{500}G$ (D) $\frac{500}{499}G$

Q.32 A uniform magnetic field of 0.3 T is established along the positive Z -direction. A rectangular loop of sides 10 cm and 5 cm lying in the xy -plane carries a current of 12 A. The torque on the loop is

- (A) $+1.8 \times 10^{-2} \hat{i} \text{ N m}$ (B) $-1.8 \times 10^{-2} \hat{j} \text{ N m}$
(C) zero (D) $-1.8 \times 10^{-2} \hat{i} \text{ N m}$

Q.33 A long cylindrical conductor of radius R carries a steady current spread uniformly over its cross-section. Which graph correctly describes the magnitude of B against the distance d from the axis?

- (A) B increases linearly up to $d = R$ and then stays constant
 (B) B is constant up to $d = R$ and then falls as $1/d$
 (C) B is zero up to $d = R$, then jumps and falls as $1/d$
 (D) B increases linearly up to $d = R$, then falls as $1/d$

Q.34 The current sensitivity of a moving coil galvanometer is 5 div/mA and its voltage sensitivity is 20 div/V . The resistance of the galvanometer is

- (A) 500Ω (B) 40Ω (C) 250Ω (D) 25Ω

Q.35 An infinitely long straight conductor carries a current of 5 A . An electron moves with speed 10^5 m/s parallel to the conductor at a perpendicular distance of 20 cm . The magnitude of the force on the electron at that instant is

- (A) $8 \times 10^{-20} \text{ N}$ (B) $4 \times 10^{-20} \text{ N}$ (C) $8\pi \times 10^{-20} \text{ N}$ (D) $4\pi \times 10^{-20} \text{ N}$

Q.36 In $\vec{F} = q(\vec{v} \times \vec{B})$ with $\vec{B} = B\hat{i} + B\hat{j} + B_0\hat{k}$, for $q = 1$, $\vec{v} = 2\hat{i} + 4\hat{j} + 6\hat{k}$ and $\vec{F} = 4\hat{i} - 20\hat{j} + 12\hat{k}$, the complete expression for $\vec{B}$ is

- (A) $6\hat{i} + 6\hat{j} - 8\hat{k}$ (B) $-8\hat{i} - 8\hat{j} - 6\hat{k}$ (C) $-6\hat{i} - 6\hat{j} - 8\hat{k}$ (D) $8\hat{i} + 8\hat{j} - 6\hat{k}$

Q.37 A long solenoid of radius 1 mm has 100 turns per mm . If a current of 1 A flows in it, the magnetic field at the centre of the solenoid is

- (A) $12.56 \times 10^{-4} \text{ T}$ (B) $6.28 \times 10^{-4} \text{ T}$ (C) $6.28 \times 10^{-2} \text{ T}$ (D) $12.56 \times 10^{-2} \text{ T}$

Q.38 A wire carrying current I along the positive X -axis has length L . It is kept in a magnetic field $\vec{B} = (2\hat{i} + 3\hat{j} - 4\hat{k}) \text{ T}$. The magnitude of the magnetic force on the wire is

- (A) $\sqrt{3} IL$ (B) $3 IL$ (C) $\sqrt{5} IL$ (D) $5 IL$

Q.39 A tightly wound 100 -turn coil of radius 10 cm carries a current of 7 A . The magnitude of the magnetic field at the centre of the coil is ($\mu_0 = 4\pi \times 10^{-7} \text{ SI units}$)

- (A) 4.4 mT (B) 44 T (C) 44 mT (D) 4.4 T

Q.40 What current should be passed through a circular ring of radius 5 cm so that the magnetic field produced at its centre is $7 \times 10^{-5} \text{ Wb/m}^2$?

- (A) 0.28 A (B) 5.57 A (C) 2.8 A (D) none of these

Q.41 A circular coil of radius R carries current I . At a distance r ($r \gg R$) on its axis, the magnetic field is proportional to

- (A) $\frac{1}{r}$ (B) $\frac{1}{r^2}$ (C) $\frac{1}{r^{3/2}}$ (D) $\frac{1}{r^3}$

Q.42 A very long straight wire carries current I_e , and a ring of radius R carrying current I_c lies in the same plane with its centre at a distance h from the wire. For what value of h is the resultant magnetic field at the centre of the ring zero?

- (A) $\frac{I_e R}{I_c \pi}$ (B) $\frac{I_c R}{I_e \pi}$ (C) $\frac{I_c \pi}{I_e R}$ (D) $\frac{I_e \pi}{I_c R}$

Q.43 A proton of kinetic energy 1 MeV moves on a circular path of radius R in a uniform magnetic field. What kinetic energy must an α -particle have to move on the same path in the same field?

- (A) 2 MeV (B) 1 MeV (C) 0.5 MeV (D) 4 MeV

Q.44 A galvanometer of resistance $50\ \Omega$ is connected to a battery of 8 V through a resistance of $3950\ \Omega$ in series. A full-scale deflection of 30 divisions is obtained. To reduce the deflection to 15 divisions, the series resistance should be _____ Ω .

- (A) 7900 (B) 2000 (C) 1950 (D) 7950

Q.45 Three very long parallel straight wires P, Q and R (Q in the middle) carry currents 20 A (downward), 40 A (upward) and 60 A (upward) respectively. The direction of the resultant force on wire Q is

- (A) normal to the plane of the paper (B) towards the right of wire Q (towards R)
(C) towards the left of wire Q (towards P) (D) along the current in Q

Q.46 An alpha particle of mass m moves on a circular path of radius r in a plane normal to a uniform magnetic field B . The time it takes to complete one revolution is

- (A) $\frac{4\pi eB}{m}$ (B) $\frac{8\pi e^2 B}{m}$ (C) $\frac{4\pi me}{B}$ (D) $\frac{\pi m}{Be}$

Q.47 Two very long straight parallel wires, separated by $2r$, each carry current I in the same direction. Point P lies in their plane, outside them, at a distance r from the nearer wire. The magnetic field at P is

- (A) $\frac{2\mu_0 I}{\pi r}$ (B) $\frac{\mu_0 I}{2\pi r}$ (C) $\frac{2\mu_0 I}{3\pi r}$ (D) $\frac{3\mu_0 I}{8\pi r}$

Q.48 An electron (mass $9.1 \times 10^{-31}\text{ kg}$, charge $1.6 \times 10^{-19}\text{ C}$) moving with velocity 10^6 m/s enters a magnetic field and describes a circle of radius 0.2 m . The intensity of the magnetic field must be _____ $\times 10^{-5}\text{ T}$.

- (A) 14.4 (B) 5.65 (C) 2.84 (D) 1.32

Q.49 A proton with 2 MeV kinetic energy moves perpendicular to a uniform magnetic field of 2.5 T. The force on the proton is _____ N. (mass of proton = $1.6 \times 10^{-27}\text{ kg}$, charge = $1.6 \times 10^{-19}\text{ C}$)

- (A) 8×10^{-11} (B) 3×10^{-10} (C) 3×10^{-11} (D) 8×10^{-12}

Q.50 Two parallel, very long straight wires each carrying 5 A are kept 1 m apart. If the currents are in the same direction, the force per unit length between them is _____ N/m. ($\mu_0 = 4\pi \times 10^{-7}\text{ SI}$)

- (A) 5×10^{-5} , attractive (B) 5×10^{-6} , attractive
(C) 5×10^{-5} , repulsive (D) 5×10^{-6} , repulsive

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	11	A	21	B	31	C	41	D
2	A	12	A	22	C	32	C	42	A
3	C	13	A	23	B	33	D	43	B
4	D	14	A	24	D	34	C	44	D
5	D	15	A	25	B	35	A	45	B
6	A	16	A	26	C	36	C	46	D
7	B	17	C	27	C	37	D	47	C
8	B	18	D	28	D	38	D	48	C
9	B	19	B	29	C	39	A	49	D
10	A	20	B	30	A	40	B	50	B

