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CLASS 12 PHYSICS · NCERT CHAPTER 4 · IMU CET PRACTICE

Moving Charges and Magnetism

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Questions: 45 MCQs

Each question has exactly one correct option. Attempt all questions first, then check the Answer Key and Solutions at the end.

- 1 The magnetic force on a charge q moving with velocity v in a field B is
(A) qvB always (B) $q(v \cdot B)$
(C) $q(B \times v)$ (D) $q(v \times B)$
- 2 The magnetic force on a charged particle moving parallel to the magnetic field is
(A) maximum (B) qvB
(C) zero (D) $qvB/2$
- 3 The work done by a magnetic field on a moving charge is
(A) qvB (B) zero
(C) negative (D) positive
- 4 The SI unit of magnetic field is
(A) henry (B) weber
(C) gauss (D) tesla
- 5 A charged particle enters a uniform magnetic field perpendicular to it. Its path is
(A) a straight line (B) a circle
(C) a helix (D) a parabola
- 6 The radius of the circular path of a charge q , mass m , speed v in a field B ($v \perp B$) is
(A) mv/qB (B) qB/mv
(C) $mvqB$ (D) m/qvB
- 7 The time period of revolution of a charged particle in a uniform magnetic field is
(A) $2\pi m/qB$, independent of speed (B) $2\pi mv/qB$
(C) $qB/2\pi m$ (D) dependent on radius
- 8 A charged particle enters a magnetic field at an angle (not 0° or 90°) to it. Its path is
(A) straight (B) parabolic
(C) helical (D) circular



- 9 A proton and an alpha particle enter a uniform magnetic field perpendicularly with the same velocity. The ratio of radii (proton : alpha) is
(A) 2 : 1 (B) 1 : 4
(C) 1 : 1 (D) 1 : 2
- 10 The cyclotron frequency is
(A) $qB/2\pi m$ (B) mv/qB
(C) $2\pi m/qB$ (D) $qBm/2\pi$
- 11 In a cyclotron, the kinetic energy acquired by a particle is limited by
(A) the radius of the dees (B) the frequency of the oscillator only
(C) the length of the gap (D) the charge only
- 12 The force on a straight conductor of length l carrying current I in a magnetic field B is
(A) $I(B \times l)$ (B) zero always
(C) IlB always (D) $I(l \times B)$
- 13 A 2 m wire carrying 5 A is placed perpendicular to a 0.1 T field. The force on it is
(A) 10 N (B) 0.1 N
(C) 0.5 N (D) 1 N
- 14 The Biot-Savart law gives the magnetic field dB due to a current element $I dl$ as
(A) $(\mu_0/2\pi) I/r$ (B) $(\mu_0/4\pi) I dl/r$
(C) $(\mu_0/4\pi) I dl \times \hat{r}/r^2$ (D) $\mu_0 I dl/r^3$
- 15 The magnetic field at the centre of a circular loop of radius R carrying current I is
(A) $\mu_0 I/2R$ (B) $\mu_0 I/4R$
(C) $\mu_0 IR/2$ (D) $\mu_0 I/2\pi R$
- 16 The magnetic field due to an infinitely long straight wire carrying current I at distance r is
(A) $\mu_0 I/4\pi r^2$ (B) $\mu_0 Ir/2\pi$
(C) $\mu_0 I/2\pi r$ (D) $\mu_0 I/2r$
- 17 The magnetic field at 10 cm from a long straight wire carrying 5 A is
(A) 10^{-4} T (B) 10^{-5} T
(C) 5×10^{-5} T (D) 10^{-6} T
- 18 The magnetic field inside a long solenoid with n turns per unit length carrying current I is
(A) $\mu_0 nI/2$ (B) $\mu_0 I/2$
(C) zero (D) $\mu_0 nI$
- 19 The field at the end of a long solenoid compared to its centre is
(A) half (B) same
(C) double (D) zero
- 20 The magnetic field inside a toroid of N turns, mean radius r and current I is
(A) zero (B) $\mu_0 NI/2\pi r$
(C) $\mu_0 I/2\pi r$ (D) $\mu_0 NI$



- 21 Ampere's circuital law states
(A) $\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 I_{\text{enclosed}}$
(B) $\oint \mathbf{E} \cdot d\mathbf{l} = 0$
(C) $\oint \mathbf{B} \cdot d\mathbf{l} = I/\mu_0$
(D) $\oint \mathbf{B} \cdot d\mathbf{A} = 0$
- 22 Two parallel wires carrying currents in the same direction
(A) attract each other
(B) repel each other
(C) exert no force
(D) rotate
- 23 The force per unit length between two long parallel wires carrying currents I_1 and I_2 separated by d is
(A) $\mu_0 I_1 I_2 / 2d$
(B) $\mu_0 I_1 I_2 / 2\pi d$
(C) $\mu_0 I_1 I_2 / 4\pi d^2$
(D) $\mu_0 I_1 I_2 d / 2\pi$
- 24 The magnetic moment of a current loop of area A carrying current I is
(A) I/A
(B) $I^2 A$
(C) IA
(D) A/I
- 25 The torque on a current loop of magnetic moment $\mathbf{m}$ in a uniform field $\mathbf{B}$ is
(A) $\mathbf{m} \times \mathbf{B}$
(B) zero always
(C) $\mathbf{m} \cdot \mathbf{B}$
(D) mB^2
- 26 A moving coil galvanometer works on the principle that
(A) a changing field induces emf
(B) a current produces heat
(C) a current-carrying coil in a magnetic field experiences a torque
(D) charges repel each other
- 27 In a moving coil galvanometer, a radial magnetic field is used to
(A) increase the resistance
(B) make the coil heavier
(C) make the deflection proportional to current (linear scale)
(D) reduce the magnetic field
- 28 Current sensitivity of a galvanometer is
(A) $NABk$
(B) k/NAB
(C) NAB/kR
(D) NAB/k
- 29 A galvanometer can be converted into an ammeter by connecting
(A) a low resistance in series
(B) a low resistance in parallel
(C) a high resistance in series
(D) a high resistance in parallel
- 30 A galvanometer can be converted into a voltmeter by connecting
(A) a high resistance in series
(B) a low resistance in parallel
(C) a low resistance in series
(D) a high resistance in parallel
- 31 A galvanometer of resistance $50 \, \Omega$ gives full-scale deflection at $1 \, \text{mA}$. The resistance needed in series to convert it into a voltmeter of range $10 \, \text{V}$ is
(A) $10000 \, \Omega$
(B) $9950 \, \Omega$
(C) $9050 \, \Omega$
(D) $950 \, \Omega$



- 32** A galvanometer of resistance $99\ \Omega$ gives full deflection at 10 mA . The shunt needed to convert it to a 1 A ammeter is
(A) $9.9\ \Omega$ (B) $0.99\ \Omega$
(C) $1\ \Omega$ (D) $0.1\ \Omega$
- 33** An ideal ammeter has
(A) infinite resistance (B) resistance equal to the circuit
(C) high resistance (D) zero resistance
- 34** An ideal voltmeter has
(A) infinite resistance (B) low resistance
(C) resistance equal to the galvanometer (D) zero resistance
- 35** The value of μ_0 is
(A) $9 \times 10^9\text{ T m/A}$ (B) $4\pi \times 10^7\text{ T m/A}$
(C) $8.85 \times 10^{-12}\text{ T m/A}$ (D) $4\pi \times 10^{-7}\text{ T m/A}$
- 36** An electron moving along $+x$ enters a magnetic field along $+y$. The force on it is along
(A) $-z$ (B) $+x$
(C) $+z$ (D) $-y$
- 37** A circular coil of 100 turns and radius 10 cm carries 1 A . The field at its centre is
(A) $6.28 \times 10^{-5}\text{ T}$ (B) $3.14 \times 10^{-4}\text{ T}$
(C) $6.28 \times 10^{-4}\text{ T}$ (D) $1.26 \times 10^{-3}\text{ T}$
- 38** A charged particle moves undeflected through crossed electric and magnetic fields E and B . Its speed is
(A) E^2/B (B) E/B
(C) EB (D) B/E
- 39** The magnetic moment of an electron revolving in an orbit of radius r with speed v is
(A) $ev/2r$ (B) $evr/2$
(C) $2evr$ (D) evr
- 40** An electron and a proton with equal kinetic energies enter a uniform magnetic field perpendicularly. Which has the larger radius?
(A) Electron (B) Both equal
(C) Proton (D) Depends on field direction
- 41** The magnetic field at the centre of a semicircular wire of radius R carrying current I is
(A) $\mu_0 I/2R$ (B) $\mu_0 I/4R$
(C) $\mu_0 I/R$ (D) $\mu_0 I/2\pi R$
- 42** The magnetic field on the axis of a circular loop at a large distance x is proportional to
(A) x (B) $1/x$
(C) $1/x^3$ (D) $1/x^2$



- 43** The magnetic field lines due to a long straight current-carrying wire are
(A) radially outward
(B) concentric circles around the wire
(C) parallel to the wire
(D) straight lines perpendicular to the wire
-
- 44** The potential energy of a magnetic dipole m in a field B at angle θ is
(A) $-mB \sin \theta$
(B) mB
(C) $mB \sin \theta$
(D) $-mB \cos \theta$
-
- 45** A rectangular coil of area 0.02 m^2 and 50 turns carries 2 A in a field of 0.5 T with its plane parallel to the field. The torque is
(A) 2 N m
(B) zero
(C) 0.5 N m
(D) 1 N m
-

Answer Key

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

Hints & Solutions

- (D) Lorentz magnetic force $F = q(\mathbf{v} \times \mathbf{B})$.
- (C) $F = qvB \sin 0^\circ = 0$.
- (B) Magnetic force is perpendicular to velocity, so it does no work; speed stays constant.
- (D) B is measured in tesla (T) = N/(A m). Gauss is CGS ($1 \text{ G} = 10^{-4} \text{ T}$).
- (B) The force is perpendicular to velocity and constant in magnitude $\rightarrow$ uniform circular motion.
- (A) $qvB = mv^2/r \rightarrow r = mv/(qB)$.
- (A) $T = 2\pi r/v = 2\pi m/(qB)$.
- (C) The parallel component gives uniform motion along B, the perpendicular component gives circular motion — together, a helix.
- (D) $r = mv/qB$. $\alpha: m = 4m_p, q = 2e \rightarrow r_\alpha = 2r_p$. Ratio 1 : 2.
- (A) $f = 1/T = qB/(2\pi m)$.
- (A) $K_{\max} = q^2 B^2 R^2 / (2m)$, depending on dee radius R and field.
- (D) $F = I \mathbf{l} \times \mathbf{B}$, magnitude $IlB \sin \theta$.
- (D) $F = IlB = 5 \times 2 \times 0.1 = 1 \text{ N}$.
- (C) $dB = (\mu_0/4\pi) I (d\mathbf{l} \times \hat{r})/r^2$.
- (A) $B = \mu_0 I / (2R)$.
- (C) Using Ampere's law: $B(2\pi r) = \mu_0 I$.
- (B) $B = 2 \times 10^{-7} \times 5/0.1 = 10^{-5} \text{ T}$.
- (D) Ampere's law gives $B = \mu_0 n I$, uniform inside.
- (A) At the ends, $B = \mu_0 n I / 2$.
- (B) $B(2\pi r) = \mu_0 N I \rightarrow B = \mu_0 N I / (2\pi r)$.
- (A) The line integral of B around a closed loop equals μ_0 times the enclosed current.
- (A) Parallel currents attract; antiparallel currents repel.



23. (B) $F/l = \mu_0 I_1 I_2 / (2\pi d)$. This defines the ampere.
24. (C) $m = NIA$ ($N = 1$ for a single loop).
25. (A) $\tau = m \times B$, magnitude $mB \sin \theta$.
26. (C) The coil turns under the torque $NIAB$, balanced by the spring's restoring torque.
27. (C) Radial field keeps the plane of the coil parallel to B , so $\tau = NIAB$ always, giving $\theta \propto I$.
28. (D) $\theta/I = NAB/k$.
29. (B) The shunt carries most of the current, keeping the ammeter's resistance low.
30. (A) The series resistance limits current and gives a high-resistance voltmeter.
31. (B) $R = V/I_g - G = 10/10^{-3} - 50 = 9950 \, \Omega$.
32. (C) $S = I_{gG}/(I - I_g) = 0.01 \times 99/0.99 = 1 \, \Omega$.
33. (D) It must not change the current it measures.
34. (A) It must draw no current from the circuit.
35. (D) Permeability of free space $\mu_0 = 4\pi \times 10^{-7} \, \text{T m A}^{-1}$.
36. (A) $F = q(\mathbf{v} \times \mathbf{B}) = (-e)(\hat{i} \times \hat{j}) = -e \hat{k} \rightarrow \text{along } -z$.
37. (C) $B = \mu_0 NI/2R = 4\pi \times 10^{-7} \times 100/(0.2) = 2\pi \times 10^{-4} \approx 6.28 \times 10^{-4} \, \text{T}$.
38. (B) $qE = qvB \rightarrow v = E/B$ (velocity selector).
39. (B) $I = ev/(2\pi r)$, $A = \pi r^2 \rightarrow m = evr/2$.
40. (C) $r = \sqrt{(2mK)/(qB)} \propto \sqrt{m}$ (same q). The proton is heavier $\rightarrow$ larger radius.
41. (B) Half of the full loop value: $(1/2)(\mu_0 I/2R) = \mu_0 I/4R$.
42. (C) $B = \mu_0 I R^2 / (2(R^2 + x^2)^{3/2}) \approx \mu_0 I R^2 / 2x^3$ for $x \gg R$.
43. (B) By the right-hand thumb rule, field lines are circles centred on the wire.
44. (D) $U = -\mathbf{m} \cdot \mathbf{B}$.
45. (D) Plane parallel to B means $\mathbf{m} \perp \mathbf{B}$: $\tau = NIAB = 50 \times 2 \times 0.02 \times 0.5 = 1 \, \text{N m}$.

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