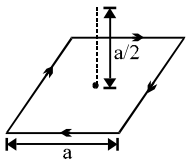
CLASS TEST

PHYSICS CLASS TEST # 44

SECTION-I

Single Correct Answer Type **5 Q. [3 M (–1)]**

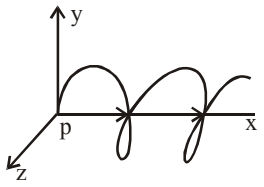
1. The magnetic field due to a current carrying square loop of side a at a point located symmetrically at a distance of a/2 from its centre (as shown is)



(A) $\frac{\sqrt{2}\,\mu_0 i}{\sqrt{3}\,\pi a}$ (B) $\frac{\mu_0 i}{\sqrt{6}\,\pi a}$ (C) $\frac{2\mu_0 i}{\sqrt{3}\,\pi a}$ (D) zero

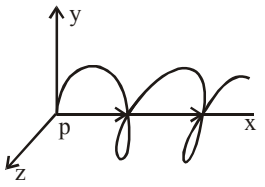
2. An electron is projected from origin with velocity $3.2\hat{i} + \hat{j}(m/s)$. A uniform magnetic field of $2\hat{k}$ tesla is present. The path followed by electron is correctly shown in ($m_e = 9 \times 10^{-31}$kg)

(A)



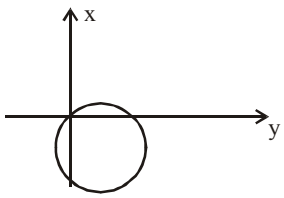
Helix on +ve side of z-axis

(B)



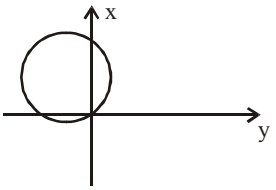
Helix on -ve side of z-axis

(C)



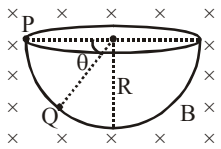
circle in xy plane

(D)



circle in xy plane

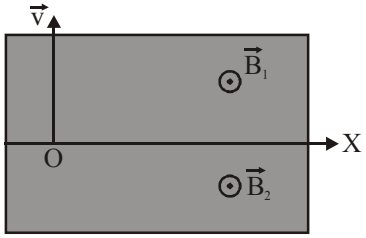
3. A charged sphere of mass m and charge –q starts sliding along the surface of a smooth hemispherical bowl, at position P. The region has a transverse uniform magnetic field B. Normal force by the surface of bowl on the sphere at position Q is :-



(A) $mg \sin\theta + qB\sqrt{2gR\sin\theta}$ (B) $3\,mg \sin\theta + qB\sqrt{2gR\sin\theta}$

(C) $mg \sin\theta - qB\sqrt{2gR\sin\theta}$ (D) $3\,mg \sin\theta - qB\sqrt{2gR\sin\theta}$

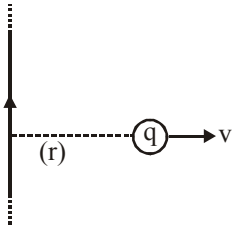
4. A charged particle is projected at a speed V = 10^6 m/s perpendicular to the boundary OX of two homogeneous magnetic fields. Magnetic induction vector fields are parallel to each other and perpendicular to the particle velocity. The average velocity of the particle till it completes a semicircle in both magnetic fields is 10^5 m/s. Then :-



(A) $B_1 : B_2 = 40 - \pi : 40 + \pi$ (B) $B_1 : B_2 = 20 - \pi : 20 + \pi$

(C) $B_1 : B_2 = 1 : 1$ (D) $B_1 : B_2 = 2\pi : 2 + \pi$

5. A charge (q, m) is thrown perpendicularly with speed v from a point at a distance r from an infinite long current (I) carrying wire. If its maximum distance from wire is R then :



(A) R will be infinite

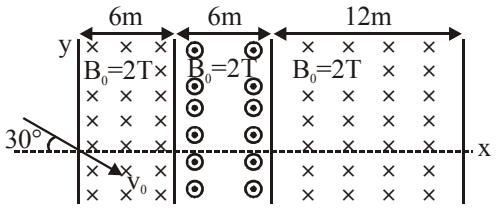
(B) R will be $\left(re^{\frac{2\pi mv}{\mu_0 qI}} \right)$

(C) R will be $\left(re^{\frac{4\pi mv}{\mu_0 qI}} \right)$

(D) R will be $\left(re^{\frac{\pi mv}{\mu_0 qI}} \right)$

Multiple Correct Answer Type 2 Q. [4 M (–1)]

6. A particle having charge 1C and mass 1 kg enters a region having uniform magnetic field of strength '2T' with a speed of 12 m/s, as shown in figure, then the **CORRECT** statement(s) is/are :-



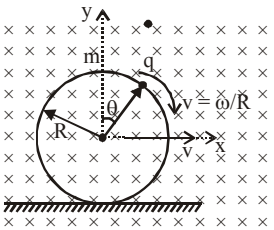
(A) The time for which the charge particle remains in magnetic field is $\frac{4\pi}{3}$ s.

(B) The velocity of charged particle becomes parallel to x-axis 6 time during its motion

(C) The distance between the point where the charge particle enters the uniform magnetic field and the point where it emerges out is 6 m

(D) The deviation of the charge particle when it emerges out of the magnetic field is $\frac{2\pi}{3}$ rad.

7. A ring of mass m and radius R is set into pure rolling on horizontal rough surface, in a uniform magnetic field of strength B as shown in the figure. A point charge q of negligible mass is attached to rolling ring. Friction is sufficient so that it does not slip at any point of its motion. (θ is measured in clockwise from positive y-axis) :-



(A) Ring will continue to move with constant velocity

(B) The value of friction acting on ring is Bqv cos θ

(C) The value of friction acting on ring is Bqv sin θ

(D) Ring will lose contact with ground if v is greater than $\left(\frac{mg}{2qB} \right)$

Linked Comprehension Type (1 Para × 3Q. & 1 Para × 2Q.) [3 M (-1)]
(Single Correct Answer Type)

Paragraph for Questions no. 8 to 10

A charge particle of mass m and charge q is projected on a rough horizontal XY plane. Both electric and magnetic fields are given by $\vec{E} = -10\hat{k}\,N/C$ and magnetic field $\vec{B} = -5\hat{k}$ tesla are present in the region. The particle enters into the magnetic field at (4, 0, 0) m with a velocity $50\hat{j}$ m/sec. The particle starts into a curved path on the plane. If coefficient of friction $\mu = \frac{1}{3}$ between particle and plane, then ($qE = 2mg$, $g = 10m/s^2$)

8. Radius of curvature of the path followed by particle, initially, is

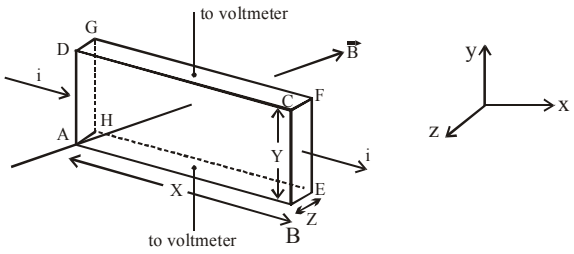
(A) 5m (B) 2.5m (C) 1.25m (D) 10m

9. The time after which particle comes to rest, is :-
(A) 5s (B) 4s (C) 3s (D) 1s

10. Total work done by electric force on the particle is
(A) 250J (B) zero (C) 125J (D) none

Paragraph for Question no. 11 and 12

When a conductor carries a current i the charge carriers move with a drift velocity v_d directed along the length of conductor. A uniform magnetic field B is applied perpendicular to current as shown in figure.
Magnetic force deflects charge carriers. As a resultant of magnetic deflection a potential difference called Hall voltage is established in transverse direction to current. In usual notations n = number of electron per unit volume, σ = conductivity of conductor, q = magnitude of charge carrier.

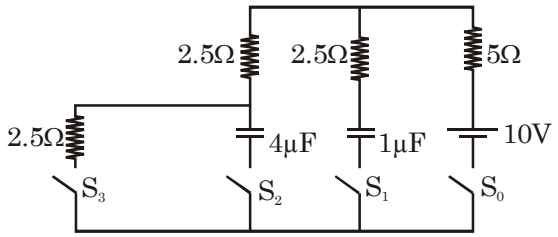


11. Mark the **CORRECT** option :
(A) In steady state face CFGD becomes positively charged
(B) Hall voltage developed across conductor has magnitude $\frac{1}{nq}\frac{iB}{Y}$
(C) An electric field is established from face ABCD towards EFGH
(D) By decreasing Z, voltage developed can be increased.

12. Direction of resultant electric field inside conductor from x-axis is given by :
(A) $\tan\alpha = \frac{\sigma B}{nq}$ (B) $\tan\alpha = \frac{iB}{\sigma n}$ (C) $\tan\alpha = \frac{\sigma n}{iB}$ (D) $\tan\alpha = \frac{ni}{\sigma B}$

Matching List Type (4 × 4 & 4 × 5) 1 Q. [3 M (–1)]

13. The circuit consists of four switches S_0, S_1, S_2, S_3 as shown below. All switches are initially open. Consider these four events in following order :-



(i) Switches S_0, S_1, S_2 are closed. Switch S_3 remains open
(ii) Now switch S_3 is also closed, so that all four switches are closed
(iii) Now switches S_0 and S_3 are opened simultaneously. Switches S_1 and S_2 are left closed.
(iv) Now S_2 is also opened and S_0 is closed. After a long time, a dielectric slab (k = 3) is inserted slowly between the plates of 1μF capacitor completely filling the gap.

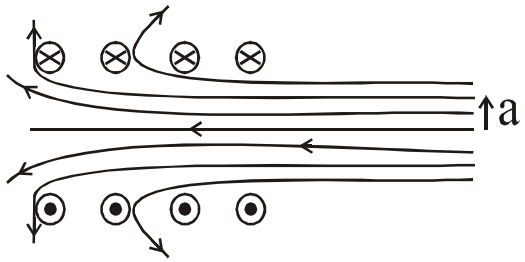
List-I		List-II
(P) Charge (in μC) on 1μF capacitor long time after event (i) is	(1)	10
(Q) Charge (in μC) on 4μF capacitor long time after event (ii) is	(2)	15
(R) Charge (in μC) on 1μF capacitor long time after event (iii) is	(3)	3
(S) Charged supplied (in μC) by the battery during event (iv) is	(4)	20
	(5)	0

(A) P → 1; Q → 2; R → 4; S → 1 (B) P → 1; Q → 1; R → 3; S → 4
(C) P → 3; Q → 3; R → 2; S → 1 (D) P → 1; Q → 2; R → 3; S → 4

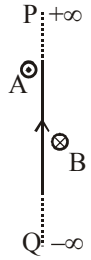
SECTION-III

Numerical Grid Type (Ranging from 0 to 9) **5 Q. [4 M (0)]**

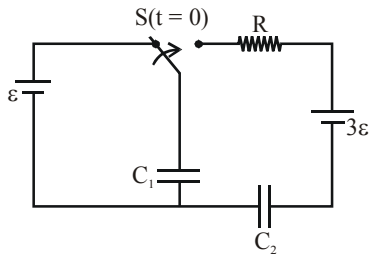
1. A direct current flows in a solenoid of length L and radius R, (L >> R), producing a magnetic field of magnitude B_0 inside the solenoid. Magnetic field line which leaves end penpendicularly is at distance 'a' from axis of solenoid. If $a = \frac{R}{\sqrt{n}}$, find n



2. Two infinitely long wires are placed perpendicular to the plane of paper. Current in wire A is $4i_0$ outward the plane of paper and current in 'B' is i_0 inward the plane of paper. The $\int_{-\infty}^{+\infty} \vec{B}.\vec{d\ell}$ along the QP is $\frac{K}{2}\mu_0 i_0$. Find the value of K.

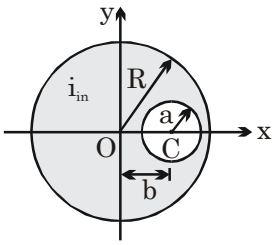


3. A capacitor C_1 (= C) is charged to a potential difference ε is connected to a charging circuit by changing the switch S as shown. Assume the instant of switching as t = 0. Capacitor C_2 is, initially uncharged, then, the charge on C_2(= C) is changing according to equation ; $q_2 = Q_2(1 - e^{-t/\delta})$. where, δ is called time constant and Q_2 is the steady state charge on C_2. Let, $Q_2 = n_2(C\varepsilon)$ and = $\delta = n_1(RC)$. Find $\left(\frac{n_2}{n_1}\right)$.



4. A galvanometer of resistance 40Ω, shunted by a resistance of 50 Ω gives a deflection of 50 divisions when joined in series with a resistance of $\frac{1000}{9}\Omega$ and a 2 volt battery, what is the current sensitivity of galvanometer (in div/mA)?

5. A very long straight conductor has a circular cross-section of radius R and carries a current density J. Inside the conductor there is a cylindrical hole of radius *a* whose axis is parallel to the axis of the conductor and a distance b from it. Let the z-axis be the axis of the conductor, and let the axis of the hole be at x = b. Find the x component of magnetic field on the y–axis at y = 2R. If your answer is $B_x = \mu_0 JR\left(\frac{1}{A} - \frac{a^2}{BR^2 + b^2}\right)$ fill value of |A| + |B|.



SECTION-IV

Matrix Match Type (4 × 5) 1 Q. [8 M (for each entry +2(0)]

1. In the column-I, there are certain situtations depicted. Match them with their description in column-II.

	Column-I		**Column-II**
(A)	A point charge is projected at an acute angle to uniform magnetic field in gravity free space	(P)	Speed changes with time
(B)	A satellite is moving around earth in an elliptical orbit	(Q)	Momentum changes with time
(C)	A charge is released from rest in uniform electric and magnetic field parallel to each other (gravity free space)	(R)	Radius of curvature of path changes with time
(D)	A charge is released from rest in uniform electric and magnetic field perpendicular to each other (gravity free space)	(S)	Acceleration is constant in magnitude
		(T)	Acceleration changes its direction with time

CLASS TEST # 44 **ANSWER KEY**

SECTION-I

Single Correct Answer Type **5 Q. [3 M (–1)]**

1. Ans. (C) **2. Ans. (C)** **3. Ans. (B)** **4. Ans. (B)**
5. Ans. (B)

Multiple Correct Answer Type **2 Q. [4 M (–1)]**

6. Ans. (A,B,D) **7. Ans. (A, C, D)**

Linked Comprehension Type **(1 Para × 3Q. & 1 Para × 2Q.) [3 M (-1)]**
(Single Correct Answer Type)

8. Ans. (A) **9. Ans. (A)** **10. Ans. (B)** **11. Ans. (D)**
12. Ans. (A)

Matching List Type (4 × 4 & 4 × 5) **1 Q. [3 M (–1)]**

13. Ans. (B)

SECTION-III

Numerical Grid Type (Ranging from 0 to 9) **5 Q. [4 M (0)]**

1. Ans. 2 **2. Ans. 5** **3. Ans. 2** **4. Ans. 6**
5. Ans. 8

SECTION-IV

Matrix Match Type (4 × 5) **1 Q. [8 M (for each entry +2(0)]**

1. Ans. (A)- Q,S,T; (B)-P,Q,R,T; (C)-P,Q,S; (D)-P,Q,R,S,T