FIITJEE

CBSE TERM - I

ALL XIITH STUDYING BATCHES

Part Test – II

PHYSICS

(9th November 2021)

Time: 1:30 Hours **Maximum Marks: 45**

General Instructions:

1. The question paper contains three sections A, B and C
2. Section A consists of 25 questions MCQ Single Option Correct, out of which students will attempt any 20 questions only. Each question carries +1 Mark.
3. Section B consists of 24 questions MCQ Single Option Correct, out of which 5 questions are Assertion-Reasoning type. Students will attempt any 20 questions only. Each question carries +1 Mark.
4 Section C consists of 6 questions MCQ Single Option Correct out of which 4 questions are based on case studies. Students will attempt any 5 questions only. Each question carries +1 Mark.
5. There is no negative marking.

Name of the Candidate : ....

Enroll Number : ....

Date of Examination : ....

PHYSICS

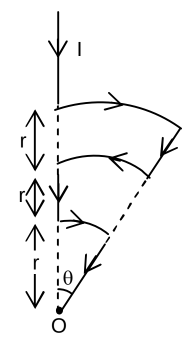
SECTION – A

This section contains 25 Multiple Choice Questions number 1 to 25. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

1. An electron moves with a velocity $\vec{u}$ in an uniform electric field $\vec{E}$. If angle between $\vec{u}$ and $\vec{E}$ is neither 0 nor π, the path followed by electron is
(A) straight line (B) circle
(C) ellipse (D) parabola

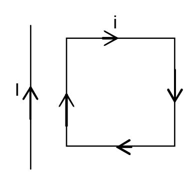
2. A wire of length ℓ metres carrying a current I amperes is bent in the form of a circle. The magnitude of the magnetic moment is
(A) $\frac{\ell I^2}{2\pi}$ (B) $\frac{\ell I^2}{4\pi}$ (C) $\frac{\ell^2 I}{2\pi}$ (D) $\frac{\ell^2 I}{4\pi}$

3. Shown in the figure is a conductor carrying a current I. The magnetic field intensity at the point O (common centre of all the three arcs) is



(A) $\frac{5\mu_0 I\theta}{24\pi r}$ (B) $\frac{\mu_0 I\theta}{24\pi r}$
(C) $\frac{11\mu_0 I\theta}{24\pi r}$ (D) zero

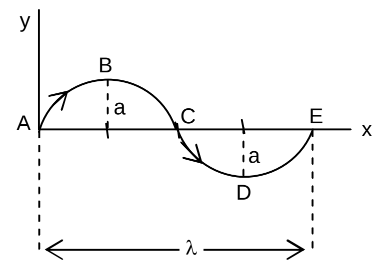
4. A rectangular loop carrying a current I is situated near a long straight wire such that the wire is parallel to one of the sides of the loop. If a steady current I is established in the wire, as shown in figure, the loop will



(A) rotate about an axis parallel to the wire (B) move away from the wire
(C) move towards the wire (D) remain stationary

5. A current flows along the length of a long thin cylindrical shell, then choose the INCORRECT statement
(A) magnetic field at all the points lying inside the shell is zero
(B) magnetic field at any point outside the shell varies inversely with distance from the surface of the shell
(C) magnetic field strength is maximum just outside the shell
(D) none of the above

6. A conductor ABCDE, shaped as shown, carries current I. It is placed in the xy-plane with the ends A and E on the x-axis. A uniform magnetic field of magnitude B exists in the region. The force acting on it will be

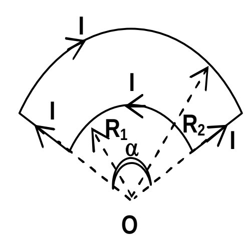


(A) zero, if B is in the Y-direction
(B) λBI in the z-direction, if B is in the +X-direction
(C) λBI in the negative y-direction, if B is in the +z-direction
(D) λBI, if B is in the negative x-direction

7. In a region, steady and uniform electric magnetic fields are present. These two fields are parallel to each other. A charged particle is released from rest in this region. The path of the particle will be
(A) circle
(B) helix
(C) straight line
(D) ellipse

8. Two particles each of mass m and charge q, are attached to the two ends of a light rigid rod of length 2ℓ. The rod is rotated at a constant angular speed about a perpendicular axis passing through its centre. The ratio of the magnitudes of the magnetic moment of the system and its angular momentum about the centre of the rod is
(A) $\frac{q}{2m}$
(B) $\frac{q}{m}$
(C) $\frac{2q}{m}$
(D) $\frac{q}{\pi m}$

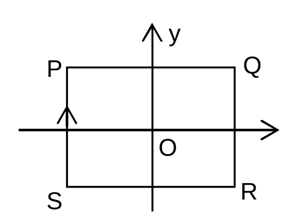
9. The magnetic induction at the centre O of the current carrying bent wire shown in the following diagram is



(A) $\frac{\mu_0 I}{4\pi R_1}\alpha$
(B) $\frac{\mu_0 I}{4\pi R_2}\alpha$
(C) $\frac{\mu_0 I\alpha}{4\pi}\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$
(D) $\frac{\mu_0 I\alpha}{4\pi}\left(\frac{1}{R_1}+\frac{1}{R_2}\right)$

10. An ionized gas contains both positive and negative ions. If it is subjected simultaneously to an electric field along the + x direction and a magnetic field along the + z direction, then
(A) positive ions deflect towards + y direction and negative ions towards – y direction
(B) all ions deflect towards + y direction
(C) all ions deflect towards – y direction
(D) positive ions deflect toward – y direction and negative ions towards + y direction

11. Figure shows a square loop PQRS in X-Y plane with its centre at the origin and carrying a current is the direction shown. There is a uniform magnetic field $\vec{B} = B_o(\hat{i} - \hat{j})$. If the coil is released from rest, it will rotate about an axis along



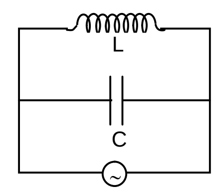
(A) z-axis
(B) QS
(C) PR
(D) x-axis

12. In LCR series AC circuit, the voltage across each of the components L, C and R is 50 V rms. The voltage across the LC combination (rms) will be
(A) 50 V
(B) $50\sqrt{2}$V
(C) 100 V
(D) zero volt

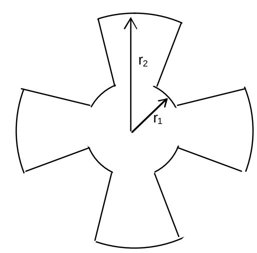
13. A non conducting ring of radius r has charge Q. A magnetic field perpendicular to the plane of the ring changes at the rate $\frac{dB}{dt}$. The torque experienced by the ring is
(A) zero
(B) $Qr^2\frac{dB}{dt}$
(C) $\frac{1}{2}Qr^2\frac{dB}{dt}$
(D) $\pi r^2 Q\frac{dB}{dt}$

14. The phase difference between the alternating current and e.m.f. is $\pi/2$. Which of the following cannot be the constituent of the circuit?
(A) LC
(B) L alone
(C) C alone
(D) R, L

15. For the circuit shown in the figure, the current through the inductor is 0.6 A, while the current through the capacitor is 0.4 A. The current drawn from the generator is
(A) 1.0 A
(B) 0.4 A
(C) 0.6 A
(D) 0.2 A



16. A current of i flow around a closed path in the circuit in clock wise direction which is in the horizontal plane as shown in the figure. The circuit consists of eight alternating areas of radii r_1 and r_2. Each subtends the same angle at the centre. Find magnetic field produced by this circuit at the centre.



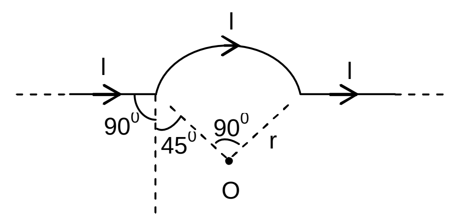
(A) $\frac{\mu_0 i}{4}\left[\frac{r_1+r_2}{r_1r_2}\right]$
(B) $\frac{\mu_0 i}{2}\left[\frac{r_1+r_2}{r_1r_2}\right]$
(C) $\frac{\mu_0 i}{8}\left[\frac{r_1+r_2}{r_1r_2}\right]$
(D) None of these

17. A current flows along the length of a long thin cylindrical shell, then which of the following statements is incorrect?
(A) Magnetic field at all the points lying inside the shell is zero.
(B) Magnetic field at any point outside the shell varies inversely with distance from the surface of the shell.
(C) Magnetic field strength is maximum just outside the shell.
(D) Magnetic field strength is minimum just outside the shell.

18. An electron of mass m_e, initially at rest, moves through a certain distance in a uniform electric field in time t_1. A proton of mass m_p, also, initially at rest, takes time t_2 to move through an equal distance in this uniform electric field. Neglecting the effect of gravity, the ratio t_2/t_1 is nearly equal to

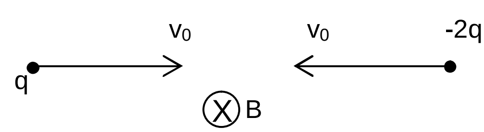
(A) 1
(B) $\left(m_p / m_e\right)^{1/2}$
(C) $\left(m_e / m_p\right)^{1/2}$
(D) 1936

19. The magnetic field at the centre O of the arc in figure is (r is the radius of circular arc)



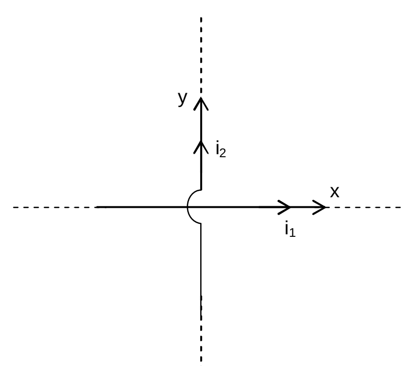
(A) $\frac{\mu_0 I}{4\pi \times r}\left[\sqrt{2}+\pi\right]$
(B) $\frac{\mu_0 I}{2\pi r}\left[\frac{\pi}{4}+1\left(\sqrt{2}-1\right)\right]$
(C) $\frac{\mu_0}{4\pi}\times\frac{I}{r}\left[\sqrt{2}+r\right]$
(D) $\frac{\mu_0}{4\pi}\times\frac{I}{r}\left[\sqrt{2}+\frac{\pi}{4}\right]$

20. A charge particle q of mass m is placed at a distance d from another charge particle – 2q of mass 2m in a uniform magnetic field B as shown. If particles are projected towards each other with equal speed v_0, so that the two particles do not collide, then maximum value of v_0 = (Assume only magnetic interaction)



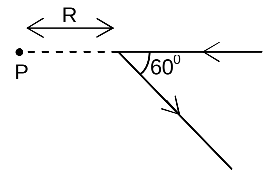
(A) $\frac{qBd}{m}$
(B) $\frac{qBd}{2m}$
(C) $\frac{2qBd}{m}$
(D) $\frac{3qBd}{2m}$

21. Two infinite wires carrying current i_1 and i_2 are lying along x and y axes, as shown in the x – y plane. Then



(A) Locus of points where magnetic field B is zero is a circle
(B) Locus of points where magnetic field B is zero is a straight line
(C) Magnetic field B decays hyperbolically along any line parallel x axis
(D) Magnetic field B decays hyperbolically along any line parallel to y axis

22. A long straight wire, carrying a current I is bent at its mid point to form an angle of 60^0 . AT a point P, distance R from the point of bending the magnetic field is



(A) $\frac{(\sqrt{2}-1)\mu_0 i}{4\pi R}$ (B) $\frac{(\sqrt{2}+1)\mu_0 i}{4\pi R}$

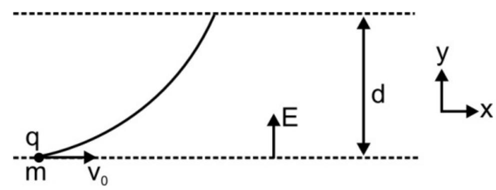
(C) $\frac{\mu_0 i}{4\sqrt{3}\pi R}$ (D) $\frac{\mu_0 i}{8R}$

23. Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of the mass of X to that of Y is

(A) $\left(\frac{R_1}{R_2}\right)^{1/2}$ (B) $\frac{R_2}{R_1}$

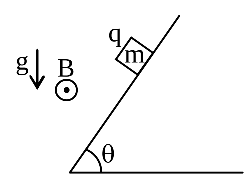
(C) $\left(\frac{R_1}{R_2}\right)^2$ (D) $\frac{R_1}{R_2}$

24. Charge q of mass m is projected with velocity v_0 along x-axis in uniform electric field E along y-axis. Radius of curvature of charge when it has travelled distance d along y-axis is ? Neglect gravity and it is given that $\frac{qEd}{m} = 2v_0^2$



(A) $\frac{v_0^2 m}{qE}\sqrt{5}$ (B) $\frac{v_0^2 m}{2qE}\sqrt{5}$ (C) $\frac{5}{2}\frac{v_0^2 m}{qE}\sqrt{5}$ (D) $\frac{5v_0^2 m}{qE}\sqrt{5}$

25. A block of mass m & charge q is released on a long smooth inclined plane. Magnetic field B is constant, uniform, horizontal and parallel to surface as shown. Find the time from start when block loses contact with the surface –

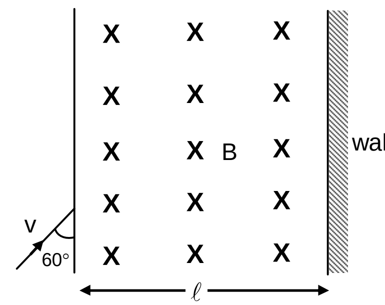


(A) $\frac{m\cos\theta}{qB}$ (B) $\frac{m\,\text{cosec}\,\theta}{qB}$ (C) $\frac{m\cot\theta}{qB}$ (D) none of these

SECTION – B

This section contains ***24 Multiple Choice Questions*** *number* ***26 to 49, out of which 5 questions are Assertion-Reasoning type.*** *Each question has 4 choices (A), (B), (C) and (D), out of which* ***ONLY ONE*** *is correct.*

26. A charge particle of mass m and charge q enters in a magnetic field B of width ℓ at the angle of $\theta = 60^\circ$ with vertical. Maximum speed at which it can enter and does not collide with wall is. [Neglect gravity]



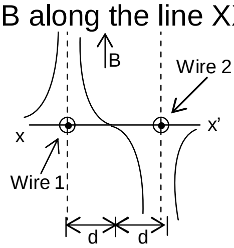
(A) $\frac{2qB\ell}{m}$

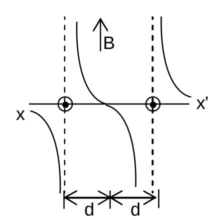
(B) $\frac{2qB\ell}{3m}$

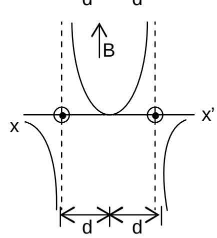
(C) $\frac{qB\ell}{2m}$

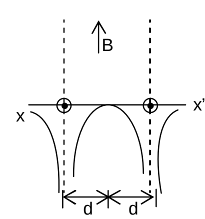
(D) $\frac{qB\ell}{m}$

27. Two long parallel wires are at a distance 2d apart. They carry steady equal currents flowing out of the plane of the paper, as shown in figure. The variation of the magnetic field B along the line XX' is given by

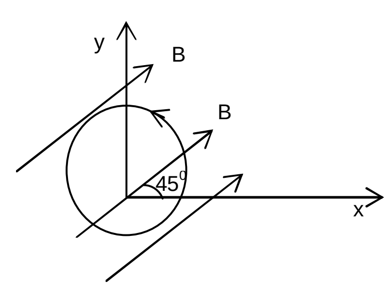
(A) 

(B) 

(C) 

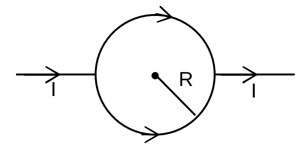
(D) 

28. A circular loop of radius R = 20 cm is placed in a uniform magnetic field $\vec{B}$ = 2T in x-y plane as shown in figure. The loop carries a current i = 1.0 A in the direction shown in figure. Find the magnitude of the torque acting on the loop.



(A) 0.35 N-m (B) 0.25 N-m (C) 0.55 N-m (D) 2.5 N-m

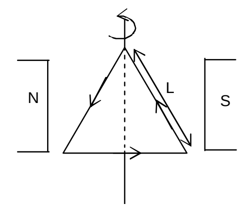
29. The magnetic field at the centre of a loop of radius R due to current of I ampere in the loop as shown will be



(A) zero
(B) $\frac{\mu_o}{4\pi}\cdot\frac{2I}{R}$
(C) $\frac{\mu_o}{4\pi}\cdot\frac{(2\pi)I}{R}$
(D) $\frac{\mu_o}{4\pi}\cdot\frac{2I(\pi-1)}{R}$

30. An electron is projected with velocity v_0 in a uniform electric field E perpendicular to the field. Again it is projected with velocity v_0 perpendicular to a uniform magnetic field B. If r_1 is initial radius of curvature just after entering in the electric field and r_2 is initial radius of curvature just after entering in magnetic field then the ratio r_1/r_2 is equal to –
(A) $\frac{Bv_0^2}{E}$
(B) $\frac{B}{E}$
(C) $\frac{Ev_0}{B}$
(D) $\frac{Bv_0}{E}$

31. A coil in shape of an equilateral triangle of side 0.02 metre is suspended from a vertex such that it is hanging in a vertical plane between pole pieces of a permanent magnet producing a horizontal magnetic field of $5\times10^{-2}T$. The couple acting on the coil when a current of 0.1 ampere is passed through it and magnetic field is parallel to its plane is

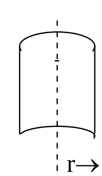


(A) $\sqrt{3}$ N – m
(B) $5\sqrt{3}\times10^{-7}$ N – m
(C) 5×10^{-7} N – m
(D) $\frac{5\sqrt{3}}{4}\times10^{-7}$ N – m

32. A coil of inductance 300 mH and resistance 2Ω is connected to a source of voltage 2V. the current reaches half of its steady state value in
(A) 0.15 s
(B) 0.3 s
(C) 0.05 s
(D) 0.1s

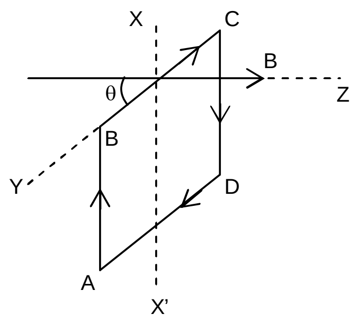
33. A charge Q is spread uniformly over on insulated ring of radius R. What is the magnetic moment of the ring if it is rotated with an angular velocity 'ω' with respect to the normal axis.
(A) $\frac{1}{2}Q\omega R^2$
(B) $\frac{1}{4}Q\cdot\omega R^2$
(C) $\frac{1}{8}Q\cdot\omega\cdot R^2$
(D) $\frac{1}{16}Q\omega R^2$

34. The current I flows along a long and thin walled half cylindrical structure of radius 'r'. The magnetic induction at a point on the axis of the cylinder is



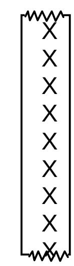
(A) $\frac{\mu_0 I}{\pi r^2}$
(B) $\frac{2\mu_0 I}{\pi r^2}$
(C) $\frac{\mu_0 I}{\pi^2 r}$
(D) $\frac{\mu_0 I}{\pi r}$

35. The square loop ABCD, carrying a current I, is placed in a uniform magnetic field B, as shown. The loop can rotate about the axis XX'. The plane of the loop makes an angle $\theta(\theta < 90^o)$ with the direction of B. through what angle will the loop rotate by itself before the torque on it becomes zero?



(A) θ (B) $90^o - \theta$
(C) $90^o + \theta$ (D) $180^o - \theta$

36. A thin infinitely large sheet lying in the y – z plane carries a current of linear current density λ. The current is in the negative y – direction and λ represents the current per unit length measured along the z – axis. The magnetic field near the sheet is



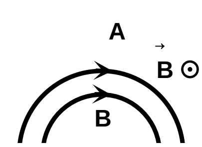
(A) $\frac{\mu_o \lambda}{4}$ (B) $\frac{\mu_o \lambda}{2}$
(C) $\mu_o \lambda$ (D) $\frac{\mu_o \lambda}{8}$

37. A charged particle is released from rest in a region of steady and uniform electric and magnetic field which are parallel to each other. The particle will move in a
(A) circle (B) parabola
(C) straight line (D) helix

38. A charged particle is projected in a magnetic field $\vec{B} = (3\hat{i} + 4\hat{j}) \times 10^{-2}$ tesla the acceleration of the particle is found to be $\vec{a} = (x\hat{i} + 2\hat{j}) m/s^2$. The value of x is
(A) 3 m/s^2 (B) – 3 m/s^2
(C) $-\frac{3}{8} m/s^2$ (D) $-\frac{8}{3} m/s^2$

39. A proton, a deuteron and an α - particle having the same kinetic energy are moving in circular trajectories in a constant magnetic field. If r_p, r_d and r_α denote respectively the radii of the trajectories of these particles, then
(A) $r_\alpha = r_p < r_d$ (B) $r_\alpha > r_d > r_p$
(C) $r_\alpha = r_p > r_d$ (D) $r_\alpha = r_d = r_\alpha$

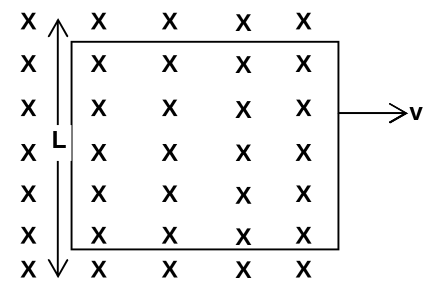
40. Two particles A and B of masses m_A and m_B respectively and having the same charge are moving in a plane. A uniform magnetic field exists perpendicular to this plane. The speeds of the particles are v_A and v_B respectively and the trajectories are as shown in the figure. Then



(A) $m_A v_A < m_B v_B$ (B) $m_A v_A > m_B v_B$
(C) $m_A < m_B$ and $v_A < v_B$ (D) $m_A = m_B$ and $v_A = v_B$

41. An α-particle and a proton have same velocity when they enter a uniform magnetic field. The period of rotation of α - particle will be
(A) two times that of proton (B) equal to that of proton
(C) four times that of proton (D) half times that of proton

42. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B constant in time and space, pointing perpendicular and into the plane at the loop exists everywhere with half the loop outside the field, as shown in figure. The induced emf is



(A) zero (B) RvB
(C) vBL/R (D) vBL

43. A coil having n turns and resistance R Ω is connected with a galvanometer of resistance 4R Ω. This combination is moved in time t seconds from a magnetic field W_1 weber to W_2 weber. The induced current in the circuit is
(A) $\frac{W_2 - W_1}{5Rnt}$ (B) $\frac{(W_2 - W_1)}{5Rt}$ (C) $\frac{(W_2 - W_1)}{Rnt}$ (D) $\frac{(W_2 - W_1)}{Rt}$

44. The surface charge density on a ring of radius 'R' and width 'd' is 'ρ'. If it rotates with frequency 'f' about its own axis; the magnetic induction at the centre is
(A) $\frac{1}{2}\pi\mu_0\rho fd$ (B) $\pi\mu_0\rho fd$
(C) $2\pi\mu_0\rho fd$ (D) $\mu_0\rho fd$

45. **Assertion:**
When a coil is connected to a cell, no current flows through it initially

Reason:
When a coil is connected to a cell, the initial emf induced in it is equal to the emf of the cell.
(A) **Assertion** is true, **Reason** is true, **Reason** is a correct explanation for **Assertion.**
(B) **Assertion** is true, **Reason** is true, **Reason** is not a correct explanation for **Assertion.**
(C) **Assertion** is true, **Reason** is false.
(D) **Assertion** is false, **Reason** is true.

46. **Assertion:**
If an electron and proton enter in a magnetic field perpendicular to field lines with equal kinetic energy, then path of the electron is more curved than that of proton.

Reason:
Electron has a tendency to form large curve due to small mass.
(A) **Assertion** is true, **Reason** is true, **Reason** is a correct explanation for **Assertion.**
(B) **Assertion** is true, **Reason** is true, **Reason** is not a correct explanation for **Assertion.**
(C) **Assertion** is true, **Reason** is false.
(D) **Assertion** is false, **Reason** is true.

47. **Assertion:**
If a proton and an α-particle enter a uniform magnetic field perpendicularly with the same speed, the time period of revolution of α-particle is double that of proton.

Reason:
In a magnetic field, the period of revolution of a charged particle is directly proportional to the mass of the particle and is inversely proportional to charge of particle.
(A) **Assertion** is true, **Reason** is true, **Reason** is a correct explanation for **Assertion.**
(B) **Assertion** is true, **Reason** is true, **Reason** is not a correct explanation for **Assertion.**
(C) **Assertion** is true, **Reason** is false.
(D) **Assertion** is false, **Reason** is true.

48. **Assertion:**
A small coil carrying current, in equilibrium, is perpendicular to the direction of the uniform magnetic field.

Reason:
Torque is maximum when plane of coil and direction of the magnetic field are parallel to each other.
(A) **Assertion** is true, **Reason** is true, **Reason** is a correct explanation for **Assertion.**
(B) **Assertion** is true, **Reason** is true, **Reason** is not a correct explanation for **Assertion.**
(C) **Assertion** is true, **Reason** is false.
(D) **Assertion** is false, **Reason** is true.

49. **Assertion:**
Hot wire instruments are used to measure A.C. only.

Reason:
Hot wire instruments measure r.m.s. value of the current/voltage.
(A) **Assertion** is true, **Reason** is true, **Reason** is a correct explanation for **Assertion.**
(B) **Assertion** is true, **Reason** is true, **Reason** is not a correct explanation for **Assertion.**
(C) **Assertion** is true, **Reason** is false.
(D) **Assertion** is false, **Reason** is true.

SECTION – C

*This section contains **6 Multiple Choice Questions** number **50 to 55, out of which 4 questions are based on case studies.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.*

50. In a uniform magnetic field of induction B a wire in the form of a semicircle of radius r rotates about the diameter of the circle with angular frequency ω . The axis of rotation is perpendicular to the field. If the total resistance of the circuit is R the mean power generated per period of rotation is

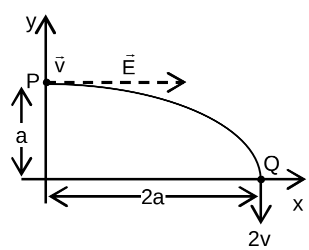
(A) $\frac{B\pi r^2\omega}{2R}$ (B) $\frac{\left(B\pi r^2\omega\right)^2}{8R}$ (C) $\frac{\left(B\pi r\omega\right)^2}{2R}$ (D) $\frac{\left(B\pi r\omega^2\right)^2}{8R}$

51. A metal conductor of length 1 m rotates vertically about one of its ends at angular velocity
5 radian per second. If the horizontal component of earth's magnetic field is 0.2×10^{-4} T, then the e.m.f. developed between the two ends of the conductor

(A) 5 μ V (B) 50 μ V
(C) 5 m V (D) 50 μ V

Case Study (52-55)

A particle of charge +q and mass m moving under the influence of a uniform electric field $E\hat{i}$ and uniform magnetic field $B\hat{k}$ follows a trajectory from P to Q as shown in figure. The velocities at P and Q are $v\hat{i}$ and $-2v\hat{j}$.



52. Electric field E equals

(A) $\frac{3}{4}\frac{mv^2}{qa}$ (B) $\frac{5}{4}\frac{mv^2}{qa}$
(C) $\frac{mv^2}{qa}$ (D) $\frac{mv^2}{2qa}$

53. Rate of work done by the electric field at P is

(A) $\frac{3}{4}\frac{mv^3}{a}$ (B) $\frac{5}{4}\frac{mv^3}{a}$
(C) $\frac{mv^3}{a}$ (D) $\frac{1}{2}\frac{mv^3}{a}$

54. Rate of work done by the magnetic fields at P is

(A) zero (B) $\frac{3}{2}\frac{mv^3}{a}$
(C) $\frac{mv^3}{a}$ (D) none of these

55. Rate of work done by both the fields at Q is

(A) zero

(B) $\frac{3}{2}\frac{mv^3}{a}$

(C) $\frac{mv^3}{a}$

(D) none of these