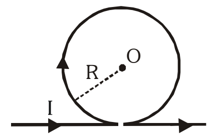
MAGNETIC EFFECTS OF CURRENT -LEVEL 1

SELECT THE CORRECT ALTERNATIVE (ONLY ONE CORRECT ANSWER)

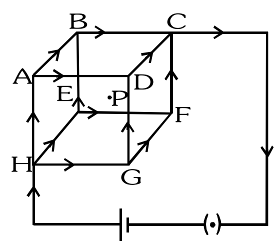
1. An infinitely long straight conductor is bent into the shape as shown in figure. It carries a current I ampere and the radius of the circular loop is r meter. Then the magnetic induction at the centre of the circular part is :–



(A) Zero (B) ∞ (C) $\frac{\mu_0}{4\pi}\frac{2I}{r}(\pi+1)$ (D) $\frac{\mu_0}{4\pi}\frac{2I}{r}(\pi-1)$

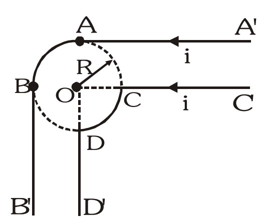
2. Two concentric coils each of radius equal to 2π cm are placed at right angles to each other. 3A and 4A are the currents flowing in each coil respectively. The magnetic induction in Wb/m^2 at the centre of the coils will be:– ($\mu_0 = 4\pi \quad 10^{-7}$ Wb/Am)
(A) $12 \quad 10^{-5}$ (B) 10^{-5} (C) $5 \quad 10^{-5}$ (D) $7 \quad 10^{-5}$

3. A steady current is set up in a cubic network composed of wires of equal resistance and length d as shown in figure. What is the magnetic field at the centre P due to the cubic network ?



(A) $\frac{\mu_0}{4\pi}\cdot\frac{2I}{d}$ (B) $\frac{\mu_0}{4\pi}\cdot\frac{3I}{\sqrt{2}d}$ (C) 0 (D) $\frac{\mu_0}{4\pi}\cdot\frac{8\pi I}{d}$

4. All straight wires are very long. Both AB and CD are arcs of the same circle, both subtending right angles at the centre O. Then the magnetic field at O is–

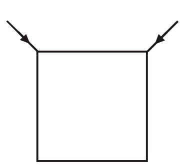
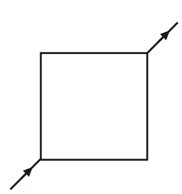
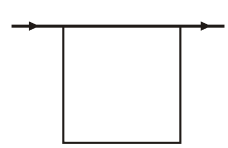
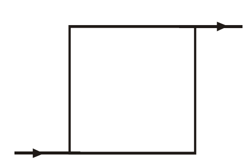


(A) $\frac{\mu_0 i}{4\pi R}$ (B) $\frac{\mu_0 i}{4\pi R}\sqrt{2}$ (C) $\frac{\mu_0 i}{2\pi R}$ (D) $\frac{\mu_0 i}{2\pi R}(\pi+1)$

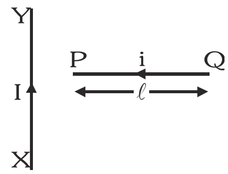
5. If the intensity of magnetic field at a point on the axis of current coil is half of that at the centre of the coil, then the distance of that point from the centre of the coil will be :–

(A) $\frac{R}{2}$ (B) R (C) $\frac{3R}{2}$ (D) 0.766R

6. Current flows through uniform, square frames as shown. In which case is the magnetic field at the centre of the frame not zero?

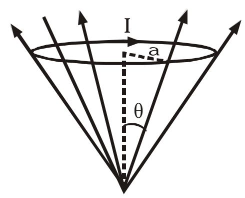
(A)  (B)  (C)  (D) 

7. A conductor PQ carries a current 'i' is placed perpendicular to a long conductor XY carrying a current I. The direction of force on PQ will be :–



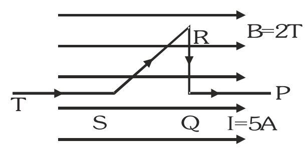
(A) towards right (B) towards left (C) upwards (D) downwards

8. A circular current loop of radius a is placed in a radial field B as shown. The net force acting on the loop is



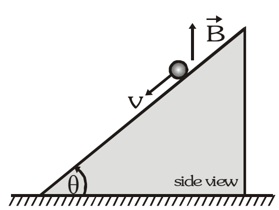
(A) zero (B) $2\pi BaI\cos\theta$ (C) $2\pi aIB\sin\theta$ (D) None

9. A wire PQRST carrying current I = 5A is placed in uniform magnetic field B = 2T as shown in fig. If the length of part QR = 4 cm and SR = 6 cm then the magnetic force on SR edge of the wire is :–



(A) 0.4 N (B) 0.6 N (C) zero (D) 6 N

10. A conducting rod of length ℓ and mass m is moving down a smooth inclined plane of inclination θ with constant velocity v in fig. A current I is flowing in the conductor in a direction perpendicular to paper inwards. A vertically upward magnetic field $\vec{B}$ exists in space. Then magnitude of magnetic field $\vec{B}$ is

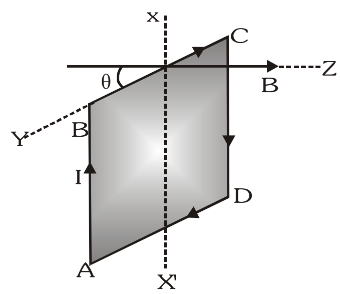


(A) $\frac{mg}{i\ell}\sin\theta$ (B) $\frac{mg}{i\ell}\tan\theta$ (C) $\frac{mg\cos\theta}{i\ell}$ (D) $\frac{mg}{i\ell\sin\theta}$

11. The unit of electric current 'Ampere' is the amount of current flowing through each of two parallel wire 1m. apart and of infinite length will give rise to a force between them equal to :–

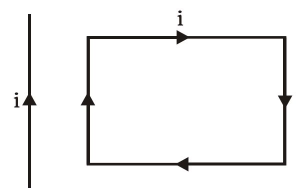
(A) 1 N/m (B) 2 10^{-7} N/m (C) 1 10^{-2} N/m (D) 4π 10^{-7} N/m

12. 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 θ (θ < 90) with the direction of B. Through what angle will the loop rotate by itself before the torque on it becomes zero–



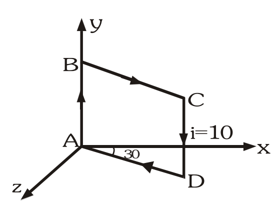
(A) θ (B) 90 – θ (C) 90 + θ (D) 180 – θ

13. 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 and is in the plane of the loop. If steady current I is established in the wire as shown in the 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

14. Figure shows a square current carrying loop ABCD of side 10 cm and current i = 10 A. The magnetic moment $\vec{M}$ of the loop is



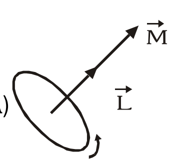
(A) $(0.05)\left(\tilde{i}-\sqrt{3}\tilde{k}\right)\ A-m^2$ (B) $(0.05)\left(\tilde{j}+\tilde{k}\right)\ A-m^2$

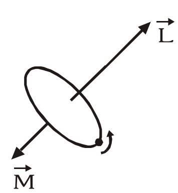
(C) $(0.05)\left(\sqrt{3}\tilde{i}+\tilde{k}\right)\ A-m^2$ (D) $\left(\tilde{i}+\tilde{k}\right)\ A-m^2$

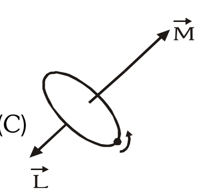
15. A helium nucleus is moving in a circular path of radius 0.8m. If it takes 2 sec to complete one revolution. Find out magnetic field produced at the centre of the circle.

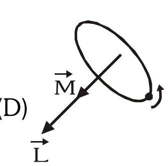
(A) $\mu_0\ 10^{-19}$ T (B) $\dfrac{10^{-19}}{\mu_0}$T (C) 2 10^{-19} T (D) $\dfrac{2\times10^{-19}}{\mu_0}$T

16. A negatively charged particle is revolving in a circle of radius r. Out of the following which one figure represents the correct directions of $\vec{L}$ and $\vec{M}$ ($\vec{L}$ is angular momentum of particle; $\vec{M}$ is magnetic moment of the particle).

(A) 

(B) 

(C) 

(D) 

17. An electron is moving along +x direction. To get it moving on an anticlockwise circular path in x–y plane, a magnetic field applied along

(A) +y–direction (B) +z–direction (C) –y–direction (D) –z–direction

18. In a region a uniform magnetic field acts in horizontal plane towards north. If cosmic particles (80% protons) falling vertically downwards, then they are deflected towards

(A) North (B) South (C) East (D) West

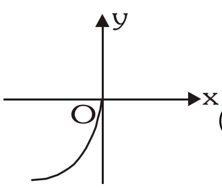
19. Two proton beams are moving with equal speed v in same direction. The ratio of electric force and magnetic force between them is – (Where c_0 is speed of light in vacuum)

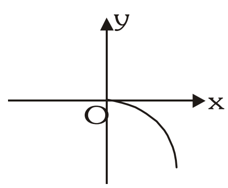
(A) $\frac{c_0^2}{v^2}$ (B) $\frac{v^2}{c_0^2}$ (C) $\frac{c_0}{v}$ (D) $\frac{v}{c_0}$

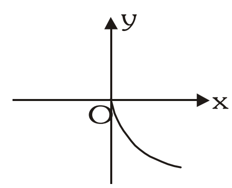
20. Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of the mass of X to that of Y is :

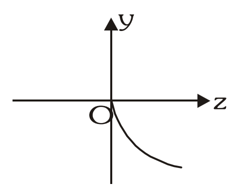
(A) $(R_1/R_2)^{1/2}$ (B) R_2/R_1 (C) $(R_1/R_2)^2$ (D) R_1/R_2

21. In a region of space uniform electric field is present as $\vec{E} = E_0\hat{j}$ and uniform magnetic field is present as $\vec{B} = B_0\hat{k}$. An electron is released from rest at origin. Which of the following best represents the path followed by electron after release.

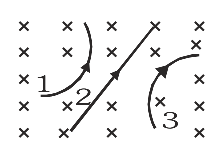
(A) 

(B) 

(C) 

(D) 

22. The charges 1, 2, 3 are moves in uniform transverse magnetic field then :–



(A) particle '1' positive and particle 3 negative

(B) particle 1 negative and particle 3 positive

(C) particle 1 negative and particle 2 neutral

(D) particle 1 and 3 are positive and particle 2 neutral

23. A charged particle moves through a magnetic field perpendicular to its direction. Then–

(A) the momentum changes but the kinetic energy is constant

(B) both momentum and kinetic energy of the particle are not constant

(C) both momentum and kinetic energy of the particle are constant

(D) kinetic energy changes but the momentum is constant

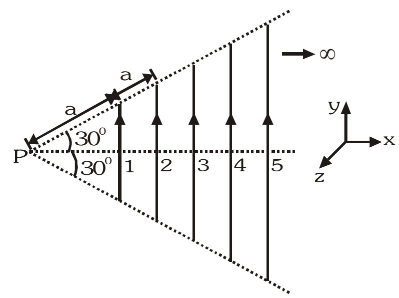
24. A proton, a deuteron and an α–particle having the same kinetic energy are moving in circular trajectories in a constant magnetic field. If r_p, r_d and r_α denote respectively the radii of the trajectories of these particles, then :

(A) $r_\alpha = r_p < r_d$ (B) $r_\alpha > r_d < r_p$ (C) $r_\alpha = r_d > r_p$ (D) $r_p = r_d = r_\alpha$

25. A charged particle moves in a magnetic field $\vec{B} = 10\hat{i}$ with initial velocity $\vec{u} = 5\hat{i} + 4\hat{j}$. The path of the particle will be

(A) straight line (B) circle (C) helical (D) None

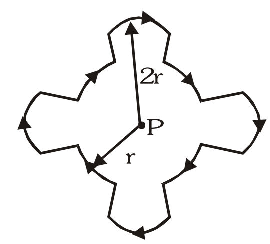
26. Infinite number of straight wires each carrying current I are equally placed as shown in the figure. Adjacent wires have current in opposite direction. Net magnetic field at point P is



(A) $\frac{\mu_0 I}{4\pi}\frac{\ell n2}{\sqrt{3}a}\tilde{k}$ (B) $\frac{\mu_0 I}{4\pi}\frac{\ell n4}{\sqrt{3}a}\tilde{k}$ (C) $\frac{\mu_0 I}{4\pi}\frac{\ell n4}{\sqrt{3}a}\left(-\tilde{k}\right)$ (D) zero

27. A particle of charge −16 10^{-18} C moving with velocity 10 ms^{-1} along the x–axis enters region where a magnetic field of induction B is along the y–axis and an electric field of magnitude 10^4 V/m is along the negative z–axis If the charged particle continues moving along the x–axis, the magnitude of B is–
(A) 10^3 Wb/m^2 (B) 10^5 Wb/m^2 (C) 10^{16} Wb/m^2 (D) 10^{-3} Wb/m^2

28. A current I flows a closed path in the horizontal plane of the circle as shown in the figure. The path consists of eight cars with alternating radii r and 2r. Each segment of arc subtends equal angle at the common centre P. The magnetic field produced by current path at point P is



(A) $\frac{3}{8}\frac{\mu_0 I}{r}$; perpendicular to the plane of the paper and directed inward

(B) $\frac{1}{8}\frac{\mu_0 I}{r}$; perpendicular to the plane of the paper and directed outward

(C) $\frac{1}{8}\frac{\mu_0 I}{r}$; perpendicular to the plane of the paper and directed inward

(D) $\frac{3}{8}\frac{\mu_0 I}{r}$ perpendicular to the plane of the paper and directed outward

29. Two mutually perpendicular conductors carrying currents I_1 and I_2 lie in one plane. Locus of the point at which the magnetic induction is zero, is a
(A) circle with centre as the point of intersection of the conductor
(B) parabola with vertex as the point of intersection of the conductors
(C) straight line passing through the point of intersection of the conductors
(D) rectangular hyperbola

30. Equal current i is flowing in three infinitely long wires along positive x, y and z directions. The magnitude of magnetic field at a point (0, 0, −a) would be

(A) $\frac{\mu_0 i}{2\pi a}\left(\tilde{j}-\tilde{i}\right)$ (B) $\frac{\mu_0 i}{2\pi a}\left(\tilde{j}+\tilde{i}\right)$ (C) $\frac{\mu_0 i}{2\pi a}\left(\tilde{i}-\tilde{j}\right)$ (D) $\frac{\mu_0 i}{2\pi a}\left(\tilde{i}+\tilde{j}+\tilde{k}\right)$

31. 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) $\frac{Bv_0}{E}$

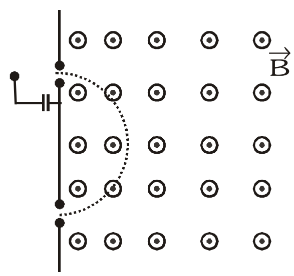
32. A uniform magnetic field $\vec{B} = B_0\hat{j}$ exists in a space. A particle of mass m and charge q is projected towards negative x–axis with speed v from the a point (d, 0, 0). The maximum value v for which the particle does not hit y–z plane is

(A) $\frac{2Bq}{dm}$ (B) $\frac{Bqd}{m}$ (C) $\frac{Bq}{2dm}$ (D) $\frac{Bqd}{2m}$

33. An electron (mass = 9.1 10^{-31}; charge = – 1.6 10^{-19} C) experiences no deflection if subjected to an electric field of 3.2 10^{5} V/m and a magnetic field of 2.0 10^{-3} Wb/m^2. Both the fields are normal to the path of electron and to each other. If the electric field is removed, then the electron will revolve in an orbit of radius

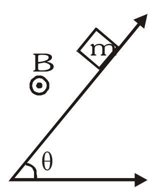
(A) 45 m (B) 4.5 m (C) 0.45 m (D) 0.045 m

34. A mass spectrometer is a device which select particle of equal mass. An iron with electric charge q > 0 starts at rest from a source S and is accelerated through a potential difference V. It passes through a hole into a region of constant magnetic field $\vec{B}$ perpendicular to the plane of the paper as shown in the figure. The particle is deflected by the magnetic field and emerges through the bottom hole at a distance d from the top hole. The mass of the particle is



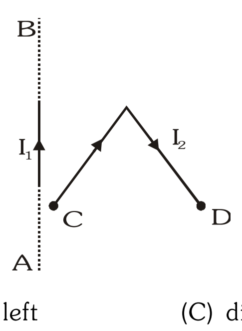
(A) $\frac{qBd}{V}$ (B) $\frac{qB^2d^2}{4V}$ (C) $\frac{qB^2d^2}{8V}$ (D) $\frac{qBd}{2V}$

35. 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



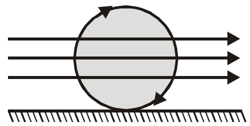
(A) $\frac{m\cos\theta}{qB}$ (B) $\frac{m\,\mathrm{cosec}\,\theta}{qB}$ (C) $\frac{m\cot\theta}{qB}$ (D) None

36. In the figure shown a current I_1 is established in the long straight wire AB. Another wire CD carrying current I_2 is placed in the plane of the paper. The line joining the ends of this wire is perpendicular to the wire AB. The force on the wire CD is



(A) zero (B) towards left (C) directed upwards (D) none of these

37. A conducting ring of mass 2 kg and radius 0.5 m is placed on a smooth horizontal plane. The ring carries a current i = 4A. A horizontal magnetic field B = 10 T is switched on at time t=0 as shown in figure. The initial angular acceleration of the ring will be



(A) $40\pi \text{ rad}/s^2$ (B) $20\pi \text{ rad}/s^2$ (C) $5\pi \text{ rad}/s^2$ (D) $15\pi \text{ rad}/s^2$

38. The dimensional formula for the physical quantity $\frac{E^2\mu_0\varepsilon_0}{B^2}$ is (E = electric field and B= magnetic field)

(A) $L^0M^0T^0$ (B) $L^1M^0T^{-1}$ (C) $L^{-1}M^0T^1$ (D) $L^{1/2}M^0T^{-1/2}$

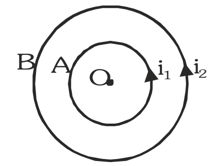
ANSWER KEY LEVEL -1

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

MAGNETIC EFFECTS OF CURRENT

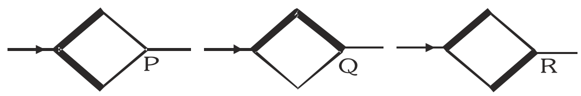
MCQs with one or more then one correct answer

1. A and B are two concentric circular conductors of centre O and carrying current i_1 and i_2 as shown in the diagram. If ratio of their radii is 1:2 and ratio of the flux densities at O due to A and B is 1:3 then the value of $\frac{i_1}{i_2}$ will be :–



(A) $\frac{1}{2}$ (B) $\frac{1}{3}$ (C) $\frac{1}{4}$ (D) $\frac{1}{6}$

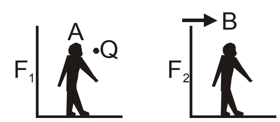
2. Two thick wires and two thin wires, all of the same materials and same length form a square in the three different ways P, Q and R as shown in fig with current direction shown, the magnetic field at the centre of the square is zero in cases



(A) in P only (B) in P and Q only (C) in Q and R only (D) P and R only

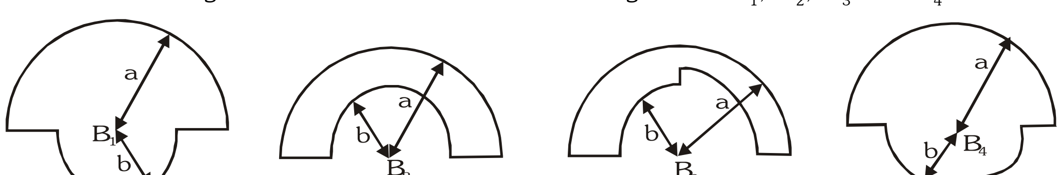
3. A moving coil galvanometer has 150 equal divisions. Its current sensitivity is 10 divisions per milli ampere and voltage sensitivity is 2 divisions per millivolt. In order that each division reads 1 V, the resistance in Ohm's needed to be connected in series with the coil will be–
(A) 10^3 (B) 10^5 (C) 99995 (D) 9995

4. An observer A and a charge Q are fixed in a stationary frame F_1. An observer B is fixed in a frame F_2, which is moving with respect to F_1.
(A) Both A and B will observe electric fields.
(B) Both A and B will observe magnetic fields.
(C) Neither A nor B will observe magnetic fields.
(D) B will observe a magnetic field, but A will not.



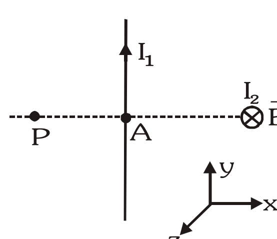
5. A long straight wire carries a current along the x–axis. Consider the points A(0, 1, 0), B(0, 1, 1), C(1, 0, 1) and D(1, 1, 1). Which of the following pairs of points will have magnetic fields of the same magnitude–
(A) A and B (B) A and C (C) B and C (D) B and D

6. In the loops shown, all curved sections are either semicircles or quarter circles. All the loops carry the same current. The magnetic fields at the centres have magnitudes B_1, B_2, B_3 and B_4



(A) B_4 is maximum. (B) B_3 is minimum. (C) $B_4 > B_1 > B_2 > B_3$ (D) $B_1 > B_4 > B_3 > B_2$

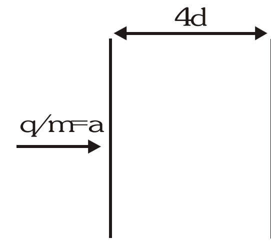
7. Two infinitely long linear conductors are arranged perpendicular to each other and are in mutually perpendicular planes as shown in figure. If I_1=2A along the y–axis and I_2 = 3A along –ve z–axis and AP = AB = 1cm. The value of magnetic field strength $\vec{B}$ at P is



(A) $(3 \quad 10^{-5}\ T)\hat{j} + (-4 \quad 10^{-5}\ T)\hat{k}$ (B) $(3 \quad 10^{-5}\ T)\hat{j} + (4 \quad 10^{-5}\ T)\hat{k}$

(C) $(4 \quad 10^{-5}\ T)\hat{j} + (3 \quad 10^{-5}\ T)\hat{k}$ (D) $(-3 \quad 10^{-5}\ T)\hat{j} + (4 \quad 10^{-5}\ T)\hat{k}$

8. If a charged particle of charge to mass ratio $q/m = \alpha$ is entering in a magnetic field of strength B at a speed $v = (2\alpha d)(B)$, then which of the following is correct?



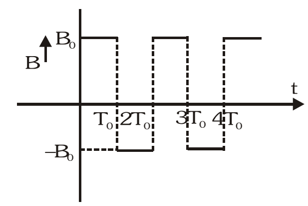
(A) Angle subtended by charged particle at the centre of circular path is 2π.

(B) The charge will move on a circular path and will come out from magnetic field at a distance 4d from the point of insertion

(C) The time for which particle will be in the magnetic field is $\frac{2\pi}{\alpha B}$

(D) The charged particle will subtend an angle of 90 at the centre of circular path

9. In a region magnetic field along x axis changes with time according to the given graph. If time period, pitch and radius of helix path are T_0, P_0 and R respectively then which of the following is incorrect if the particle is projected at an angle θ_0 with the positive x–axis in x–y plane ?



(A) At $t = \frac{T_0}{2}$, co–ordinates of charge are $\left(\frac{P_0}{2}, 0, -2R_0\right)$

(B) At $t = \frac{3T_0}{2}$, co–ordinates of charges are $\left(\frac{3P_0}{2}, 0, 2R_0\right)$

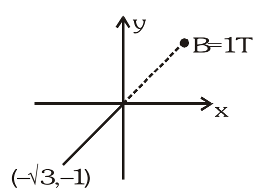
(C) Two extremes from x–axis are at a distance $2R_0$ from each other

(D) Two extremes from x–axis are at a distance $4R_0$ from each other

10. There exists a uniform magnetic and electric field of magnitude 1 T and 1 V/m respectively along positive y–axis. A charged particle of mass 1 kg and of charge 1 C is having velocity 1 m/s along x–axis and is at origin at t = 0. Then the co–ordinates of particle at time π seconds will be–

(A) (0, 1, 2) (B) $(0, -\pi^2/2, -2)$ (C) $(2, \pi^2/2, 2)$ (D) $(0, \pi^2/2, 2)$

11. A uniform magnetic field of magnitude 1 T exists in region $y \geq 0$ is along $\hat{k}$ direction as shown. A particle of charge 1 C is projected from point $(-\sqrt{3}, -1)$ towards origin with speed 1 m/s. If mass of particle is 1 kg, then co–ordinates of centre of circle in which particle moves are



(A) $(1, \sqrt{3})$ (B) $(1, -\sqrt{3})$ (C) $\left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$ (D) $\left(\frac{\sqrt{3}}{2}, -\frac{1}{2}\right)$

12. A uniform magnetic field of 1.5 T exists in a cylindrical region of radius 10.0 cm, it's direction being parallel to the axis along east to west. A current carrying wire in north south direction passes through this region. The wire intersects the axis and experience a force of 1.2 N downward. If the wire is turned from North South to north east–south west direction, then magnitude and direction of force is–

(A) 1.2 N, upward (B) $1.2\sqrt{2}$ N, downward (C) 1.2 N, downward (D) $\frac{1.2}{\sqrt{2}}$ N, downward

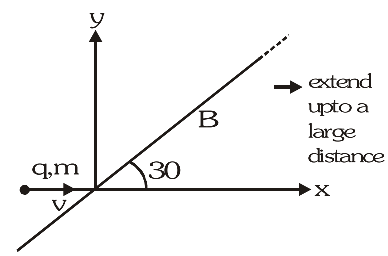
13. A charge particle of charge q, mass m is moving with initial velocity 'v' as shown in figure in a uniform magnetic field $-B\hat{k}$. Select the correct alternative/alternatives–

(A) Velocity of particle when it comes out from magnetic field is $\vec{v} = v\cos 30°\hat{i} - v\sin 30°\hat{j}$

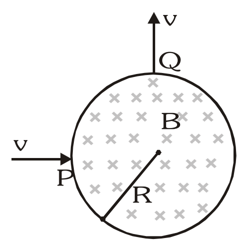
(B) Time for which the particle was in magnetic field is $\frac{\pi m}{3qB}$

(C) Distance travelled in magnetic field is $\frac{\pi mv}{3qB}$

(D) The particle will never come out of magnetic field



14. A particle of charge 'q' and mass 'm' enters normally (at point P) in a region of magnetic field with speed v. It comes out normally from Q after time T as shown in figure. The magnetic field B is present only in the region of radius R and is uniform. Initial and final velocities are along radial direction and they are perpendicular to each other. For this to happen, which of the following expression(s) is/are correct–



(A) $B = \frac{mv}{qR}$ (B) $T = \frac{\pi R}{2v}$ (C) $T = \frac{\pi m}{2qB}$ (D) None of these

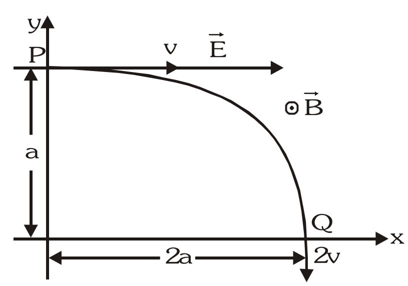
15. A particle of charge +q and mass m moving under the influence of a uniform electric field $E\hat{i}$ and uniform magnetic field $B\hat{k}$ follows a trajectory from P to Q as shown in figure. The velocities at P and Q are $v\hat{i}$ and $-2\hat{j}$, Which of the following statement(s) is/are correct ?

(A) $E = \frac{3}{4}\left[\frac{mv^2}{qa}\right]$

(B) Rate of work done by the electric field at P is $\frac{3}{4}\left[\frac{mv^3}{a}\right]$

(C) Rate of work done by the electric field at P is zero

(D) Rate of work done by both the fields at Q is zero

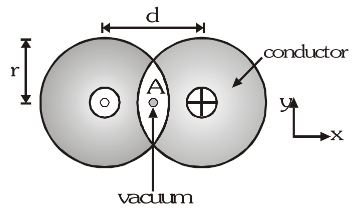


16. H^+, He^+ and O^{2+} all having the same kinetic energy pass through a region in which there is a uniform magnetic field perpendicular to their velocity. The masses of H^+, He^+ and O^{2+} are 1 amu, 4 amu and 16 amu respectively. Then :

(A) H^+ will be deflected most (B) O^{2+} will be deflected most

(C) He^+ and O^{2+} will be deflected equally (D) All will be deflected equally

17. Two long conductors are arranged as shown above to form overlapping cylinders, each of radius r, whose centers are separated by a distance d. Current of density J flows into the plane of the page along the shaded part of one conductor and an equal current flows out of the plane of the page along the shaded portion of the other, as shown. What are the magnitude and direction of the magnetic field at point A?



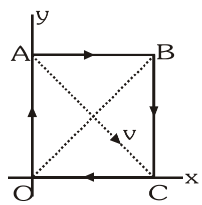
(A) $\left(\frac{\mu_0}{2\pi}\right)\pi dJ$, in the +y–direction

(B) $\left(\frac{\mu_0}{2\pi}\right)\frac{d^2}{r}$, in the +y direction

(C) $\left(\frac{\mu_0}{2\pi}\right)\frac{4d^2J}{r}$, in the –y direction

(D) $\left(\frac{\mu_0}{2\pi}\right)\frac{Jr^2}{d}$, in the –y direction

18. OABC is a current carrying square loop. An electron is projected from the centre of loop along its diagonal AC as shown. Unit vector in the direction of initial acceleration will be



(A) $\tilde{k}$

(B) $-\left(\frac{\tilde{i}+\tilde{j}}{\sqrt{2}}\right)$

(C) $-\tilde{k}$

(D) $\frac{\tilde{i}+\tilde{j}}{\sqrt{2}}$

19. A particle of specific charge (charge/mass) α starts moving from the origin under the action of an electric field $\vec{E} = E_0\tilde{i}$ and magnetic field $\vec{B} = B_0\tilde{k}$. Its velocity at $(x_0, y_0, 0)$ is $\left(4\tilde{i} - 3\tilde{j}\right)$. The value of x_0 is

(A) $\frac{13\alpha E_0}{2B_0}$

(B) $\frac{16\alpha B_0}{E_0}$

(C) $\frac{25}{2\alpha E_0}$

(D) $\frac{5\alpha}{2B_0}$

20. An electron moving with a velocity $\vec{v}_1 = 2\tilde{i}$ m/s at a point in a magnetic field experiences a force $\vec{F}_1 = -2\tilde{j}N$. If the electron is moving with a velocity $\vec{v}_2 = 2\tilde{j}$ m/s at the same point, it experiences a force $\vec{F}_2 = +2\tilde{i}N$. The force the electron would experience if it were moving with a velocity $\vec{v}_3 = 2\tilde{k}$ m/s at the same point is

(A) zero

(B) $2\tilde{k}N$

(C) $-2\tilde{k}N$

(D) Information is insufficient

21. Two particles of charges +Q and –Q are projected from the same point with a velocity v in a region of uniform magnetic field B such that the velocity vector makes an angle θ with the magnetic field. Their masses are M and 2M, respectively. Then, they will meet again for the first time at a point whose distance from the point of projection is

(A) $\frac{2\pi Mv\cos\theta}{QB}$

(B) $\frac{8\pi Mv\cos\theta}{QB}$

(C) $\frac{\pi Mv\cos\theta}{QB}$

(D) $\frac{4\pi Mv\cos\theta}{QB}$

22. A conductor of length ℓ and mass m is placed along the east–west line on a table. Suddenly a certain amount of charge is passed through it and it is found to jump to a height h. The earth's magnetic induction is B. The charge passed through the conductor is

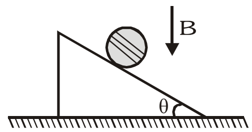
(A) $\frac{1}{Bmgh}$

(B) $\frac{\sqrt{2gh}}{B\ell m}$

(C) $\frac{gh}{B\ell m}$

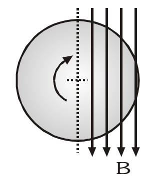
(D) $\frac{m\sqrt{2gh}}{B\ell}$

23. In the figure shown a coil of single turn is wound on a sphere of radius R and mass m. The plane of the coil is parallel to the plane and lies in the equatorial plane of the sphere. Current in the coil is i. The value of B if the sphere is in equilibrium is



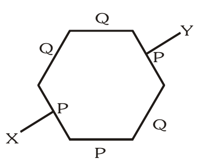
(A) $\frac{mg\cos\theta}{\pi iR}$ (B) $\frac{mg}{\pi iR}$ (C) $\frac{mg\tan\theta}{\pi iR}$ (D) $\frac{mg\sin\theta}{\pi iR}$

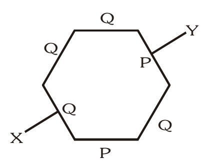
24. A thin non conducting disc of radius R is rotating clockwise (see figure) with an angular velocity ω about its central axis, which is perpendicular to its plane. Both its surfaces carry +ve charges of uniform surface density. Half the disc is in a region of a uniform, unidirectional magnetic field B parallel to the plane of the disc, as shown. Then,

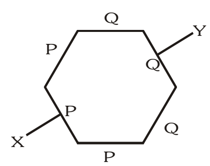


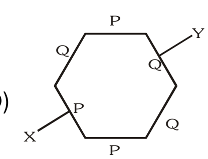
(A) The net torque on the disc is zero
(B) The net torque vector on the disc is directed leftwards
(C) The net torque vector on the disc is directed rightwards
(D) The net torque vector on the disc is parallel to B

25. In the following hexagons, made up of two different material P and Q, current enters and leaves from points X and Y respectively. In which case the magnetic field at its centre is not zero

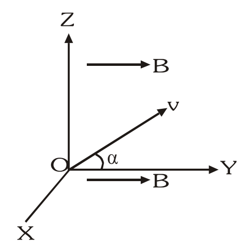
(A) 

(B) 

(C) 

(D) 

26. In a region of space, a uniform magnetic field B exists in the y–direction. A proton is fired from the origin, with its initial velocity v making a small angle α with the y–direction in the yz plane. In the subsequent motion of the proton



(A) its x–coordinate can never be positive
(B) its x– and z–coordinates cannot both be zero at the same time
(C) its z–coordinate can never be negative
(D) its y–coordinate will be proportional to the square of its time of flight

27. A particle of charge per unit mass α is released from origin with velocity $\vec{v} = v_0\hat{i}$ in a magnetic field $\vec{B} = -B_0\hat{k}$ for $x \le \frac{\sqrt{3}}{2}\frac{v_0}{B_0\alpha}$ and $\vec{B} = 0$ for $x > \frac{\sqrt{3}}{2}\frac{v_0}{B_0\alpha}$. The x–coordinates of the particle at time $t\left(>\frac{\pi}{3B_0\alpha}\right)$ would be

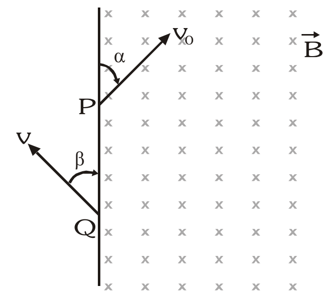
(A) $\frac{\sqrt{3}}{2}\frac{v_0}{B_0\alpha} + \frac{\sqrt{3}}{2}v_0\left(t - \frac{\pi}{B_0\alpha}\right)$ (B) $\frac{\sqrt{3}}{2}\frac{v_0}{B_0\alpha} + v_0\left(t - \frac{\pi}{3B_0\alpha}\right)$

(C) $\frac{\sqrt{3}}{2}\frac{v_0}{B_0\alpha} + \frac{v_0}{2}\left(t - \frac{\pi}{3B_0\alpha}\right)$ (D) $\frac{\sqrt{3}}{2}\frac{v_0}{B_0\alpha} + \frac{v_0 t}{2}$

28. A charged particle of specific charge α is released from origin at time t = 0 with velocity $\vec{v} = v_0(\hat{i} + \hat{j})$ in uniform magnetic field $\vec{B} = B_0\hat{i}$. Coordinates of the particle at time $t = \frac{\pi}{B_0\alpha}$ are

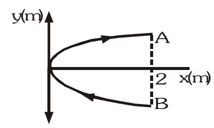
(A) $\left(\frac{v_0}{2B_0\alpha}, \frac{\sqrt{2}v_0}{\alpha B_0}, \frac{-v_0}{B_0\alpha}\right)$ (B) $\left(\frac{-v_0}{2B_0\alpha}, 0, 0\right)$ (C) $\left(0, \frac{2v_0}{B_0\alpha}, \frac{v_0\pi}{2B_0\alpha}\right)$ (D) $\left(\frac{v_0\pi}{B_0\alpha}, 0, \frac{-2v_0}{B_0\alpha}\right)$

29. A particle of charge $-q$ and mass m enters a uniform magnetic field $\vec{B}$ (perpendicular to paper inwards) at P with a velocity v_0 at an angle α and leaves the field at Q with velocity v at angle β as shown in fig., then



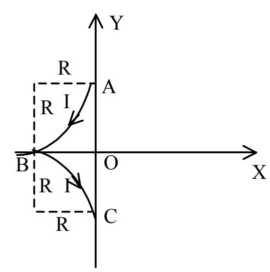
(A) $\alpha = \beta$
(B) $v = v_0$
(C) $PQ = \dfrac{2mv_0 \sin\alpha}{Bq}$
(D) Particle remains in the field for time $t = \dfrac{2m(\pi - \alpha)}{Bq}$

30. A conducting wire bent in the form of a parabola $y^2 = 2x$ carries a current i=2A as shown in figure. This wire is placed in a uniform magnetic field $\vec{B} = -4\tilde{k}$ Tesla. The magnetic force on the wire is (in newton)



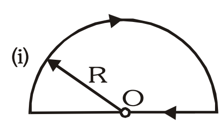
(A) $-16\tilde{i}$ (B) $32\tilde{i}$ (C) $-32\tilde{i}$ (D) $16\tilde{i}$

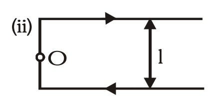
31. Conductor ABC consist of two quarter circular path of radius R lies in X–Y plane and carries current I as shown. A uniform magnetic field $\vec{B}$ is switched on in the region that exert force $\vec{F} = \sqrt{2}IRB_0\tilde{k}$ on conductor ABC. $\vec{B}$ can be



(A) $\dfrac{B_0}{\sqrt{2}}\left(-\tilde{i}\right)$ (B) $\dfrac{B_0}{\sqrt{2}}\tilde{i}$
(C) $\dfrac{B_0}{\sqrt{2}}\left(\tilde{i} + \tilde{j}\right)$ (D) Both (B) and (C).

32. Find the magnitude and direction of a force vector acting on a unit length of a thin wire, carrying a current I = 8.0A, at a point O, if the wire is bent as shown in Figure (i) the curvature radius R = 10 cm. Figure (ii) the distance between the long parallel segments of the wire l= 20 cm. F_1 = force vector due to figure (i) F_2 = force vector due to figure (ii)





(A) F_1 = 0.20 mN/m (B) F_2 = 0.13 mN/m (C) F_1 = 0.13 mN/m (D) F_2 = 0.20 mN/m

33. A stationary, circular wall clock has a face with a radius of 15 cm. Six turns of wire are wounded around its perimeter, the wire carries a current 2.0 A in the clockwise direction. The clock is located, where there is a constant, uniform external magnetic field of 70 mT (but the clock still keeps perfect time) at exactly 1:00 pm, the hour hand of the clock points in the direction of the external magnetic field
(A) Magnitude of the torque on the winding due to the magnetic field is $3.12\ 10^{-2}$ N–m.
(B) After 20 minutes the minute hand will point in the direction of the torque on the winding due to the magnetic field.
(C) Magnitude of the torque on the winding due to the magnetic field is $5.94\ 10^{-2}$ N–m.
(D) After 30 minutes the minute hand will point in the direction of the torque on the winding due to the magnetic field.

34. Consider the magnetic field produced by a finitely long current carrying wire
(A) The lines of field will be concentric circles with centres on the wire
(B) There can be two points in the same plane where magnetic fields are same
(C) There can be large number of points where the magnetic field is same
(D) The magnetic field at a point is inversely proportional to the distance of the point from the wire

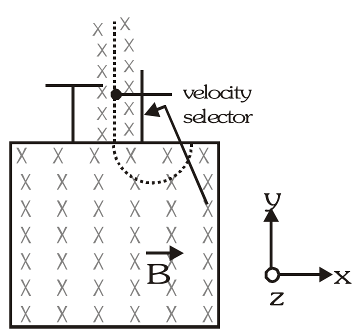
35. Which of the following statement is correct ?
(A) A charge particle enters a region of uniform magnetic field at an angle 85 to magnetic lines of force. The path of the particle is a circle
(B) An electron and a proton are moving with the same kinetic energy along the same direction. When they pass through uniform magnetic field perpendicular to their direction of motion, they describe circular path
(C) There is no change in the energy of a charged particle moving in a magnetic field although magnetic force acts on it
(D) Two electrons enter with the same speed but in opposite direction in a uniform transverse magnetic field. Then the two describe circle of the same radius and these move in the same direction

36. Two identical charged particles enter a uniform magnetic field with same speed but at angles 30 and 60 with field. Let a, b and c be the ratio of their time periods, radii and pitches of the helical paths than
(A) abc =1 (B) abc >1 (C) abc <1 (D) a = bc

37. Consider the following statements regarding a charged particle in a magnetic field. Which of the statements are true ?
(A) Starting with zero velocity, it accelerates in a direction perpendicular to the magnetic field
(B) While deflection in magnetic field its energy gradually increases
(C) Only the component of magnetic field perpendicular to the direction of motion of the charged particle is effective in deflecting it
(D) Direction of deflecting force on the moving charged particle is perpendicular to its velocity

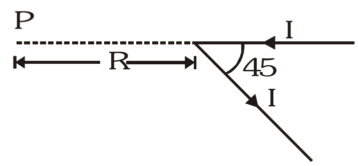
38. A particle of charge q and velocity v passes undeflected through a space with non–zero electric field E and magnetic field B. The undeflecting conditions will hold if
(A) signs of both q and E are reversed
(B) signs of both q and B are reversed
(C) both B and E are changed in magnitude, but keeping the product of $|B|$ and $|E|$ fixed.
(D) both B and E are doubled in magnitude

39. Two charged particle A and B each of charge +e and masses 12 amu and 13 amu respectively follow a circular trajectory in chamber X after the velocity selector as shown in the figure. Both particles enter the velocity selector with speed 1.5×10^6 ms^{-1}. A uniform magnetic field of strength 1.0 T is maintained within the chamber X and in the velocity selector.



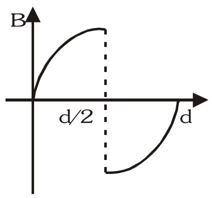
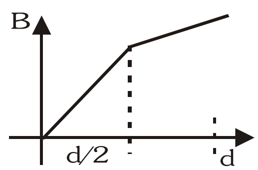
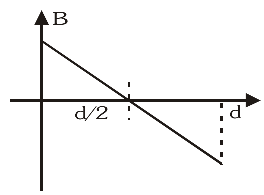
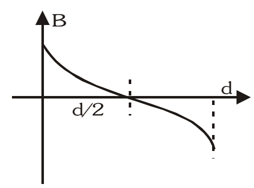
(A) Electric field across the conducting plate of the velocity selector is $-10^6\ NC^{-1}\,\tilde{i}$
(B) Electric field across the conducting plate of the velocity selector is $10^6\ NC^{-1}\,\tilde{i}$
(C) The ratio $\frac{r_A}{r_B}$ of the radii of the circular paths for the two particles is 12/13
(D) The ratio $\frac{r_A}{r_B}$ of the radii of the circular paths for the two particles is 13/12

40. A long straight wire, carrying current I, is bent at its midpoint to form an angle of 45°. Magnetic field at point P, distance R from point of bending is equal to

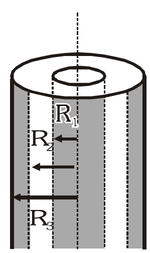


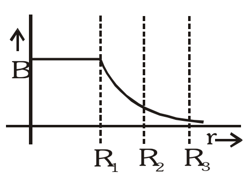
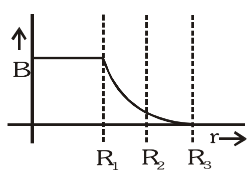
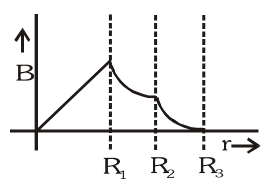
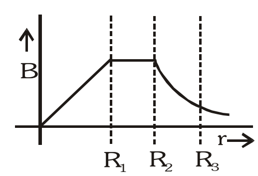
(A) $\frac{(\sqrt{2}-1)\mu_0 I}{4\pi R}$ (B) $\frac{(\sqrt{2}+1)\mu_0 I}{4\pi R}$ (C) $\frac{(\sqrt{2}+1)\mu_0 I}{4\sqrt{2}\pi R}$ (D) $\frac{(\sqrt{2}-1)\mu_0 I}{4\sqrt{2}\pi R}$

41. A uniform beam of positively charged particles is moving with a constant velocity parallel to another beam of negatively charged particles moving with the same velocity in opposite direction separated by a distance d. The variation of magnetic field B along a perpendicular line draw between the two beams is best represented by

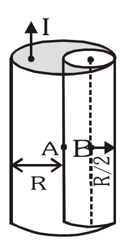
(A)  (B)  (C)  (D) 

42. A coaxial cable is made up of two conductors. The inner conductor is solid and is of radius R_1 and the outer conductor is hollow of inner radius R_2 and outer radius R_3. The space between the conductors is filled with air. The inner and outer conductors are carrying currents of equal magnitudes and in opposite directions. Then the variation of magnetic field with distance from the axis is best plotted as



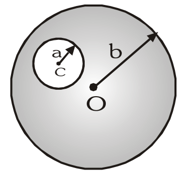
(A)  (B)  (C)  (D) 

43. From a cylinder of radius R, a cylinder of radius R/2 is removed, as shown. Current flowing in the remaining cylinder is I. Magnetic field strength is–



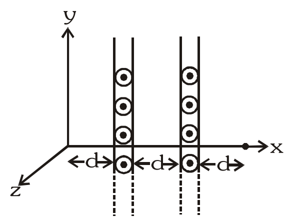
(A) zero at point A (B) zero at point B (C) $\frac{\mu_0 I}{3\pi R}$ at point A (D) $\frac{\mu_0 I}{3\pi R}$ at point B

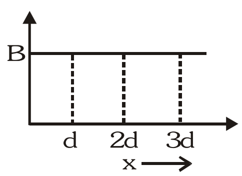
44. A long straight metal rod has a very long hole of radius 'a' drilled parallel to the rod axis as shown in the figure. If the rod carries a current 'i' find the value of magnetic induction on the axis of the hole, where OC=c

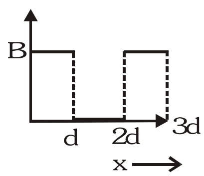


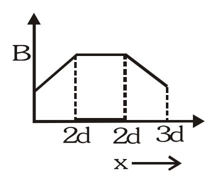
(A) $\frac{\mu_0 ic}{\pi(b^2-a^2)}$ (B) $\frac{\mu_0 ic}{2\pi(b^2-a^2)}$ (C) $\frac{\mu_0 i(b^2-a^2)}{2\pi c}$ (D) $\frac{\mu_0 ic}{2\pi a^2 b^2}$

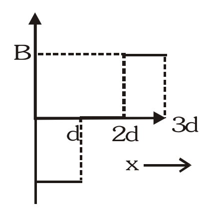
45. Two large conducting current planes perpendicular to x–axis are placed at (d, 0) and (2d, 0) as shown in figure. Current per unit width in both the planes is same and current is flowing in the outward direction. The variation of magnetic induction as function of 'x' ($0 \le x \le 3d$) is best represented by–



(A) 

(B) 

(C) 

(D) 

46. The magnetic moment of a short magnet is 8 Am^2 . The magnetic induction at a point 20cm away from its mid point on (i) axial point (ii) equatorial point respectively, will be :–

(A) 2 10^{-4} and 10^{-4} T (B) 3 10^{-4} and 2 10^{-4} T (C) 4 10^{-4} and 3 10^{-4} T (D) None of these

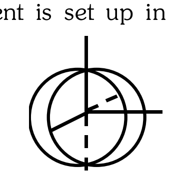
47. A magnetic needle lying parallel to a magnetic field requires W unit of work to turn it through 60 . The torque needed to maintain the needle in this position will be–

(A) $\sqrt{3}$ W (B) W (C) ($\sqrt{3}$ /2)W (D) 2W

48. A short bar magnet placed with its axis at 30 with a uniform external magnetic field of 0.16T experiences a torque of magnitude 0.032 J. The magnetic moment of the bar moment will be

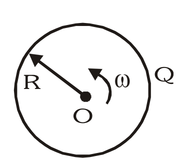
(A) 0.23 J/T (B) 0.40 J/T (C) 0.80J/T (D) Zero

49. Two insulated rings, one of slightly smaller diameter than the other, are suspended along their common diameter as shown. Initially the planes of the rings are mutually perpendicular. When a steady current is set up in each of them.



(A) The two rings rotate into a common plane
(B) The inner ring oscillates about its initial position
(C) The outer ring stays stationary while the inner one moves into the plane of the outer ring
(D) The inner ring stays stationary while the outer one moves into the plane of the inner ring.

50 A nonconducting disc having uniform positive charge Q, is rotating about its axis with uniform angular velocity ω. The magnetic field at the centre of the disc is–



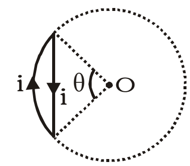
(A) directed outward (B) having magnitude $\frac{\mu_0 Q\omega}{4\pi R}$

(C) directed inwards (D) having magnitude $\frac{\mu_0 Q\omega}{2\pi R}$

51. A electron experiences a force $\left(4.0\hat{i}+3.0\hat{j}\right)$ 10^{-13} N in a uniform magnetic field when its velocity is $2.5\hat{k}\times10^{7}$ ms^{-1}. When the velocity is redirected and becomes $\left(1.5\hat{i}-2.0\hat{j}\right)\times10^{7}$ ms^{-1}, the magnetic force of the electron is zero. The magnetic field vector $\vec{B}$ is

(A) $-0.075\hat{i}+0.1\hat{j}$ (B) $0.1\hat{i}+0.075\hat{j}$ (C) $0.075\hat{i}-0.1\hat{j}+\hat{k}$ (D) $0.075\hat{i}-0.1\hat{j}$

52. Net magnetic field at the centre of the circle O due to a current carrying loop as shown in figure is $\left(\theta<180^{\circ}\right)$



(A) zero
(B) perpendicular to paper inwards
(C) perpendicular to paper outwards
(D) is perpendicular to paper inwards if $\theta\le90^{\circ}$ and perpendicular to paper outwards if $90^{\circ}\le\theta<180^{\circ}$

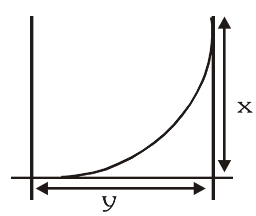
53. A particle of charge q and mass m starts moving from the origin under the action of an electric field $\vec{E}=E_0\hat{i}$ and $\vec{B}=B_0\hat{i}$ with velocity $\vec{v}=v_0\hat{j}$. The speed of the particle will become $2v_0$ after a time

(A) $t=\dfrac{2mv_0}{qE}$ (B) $t=\dfrac{2Bq}{mv_0}$ (C) $t=\dfrac{\sqrt{3}Bq}{mv_0}$ (D) $t=\dfrac{\sqrt{3}mv_0}{qE}$

54. A particle of specified charge (q/m) is projected from the origin of coordinates with initial velocity $\left[u\hat{i}-v\hat{j}\right]$. Uniform electric magnetic fields exists in the region along the +y direction, of magnitude E and B. The particle will definitely return to the origin once if

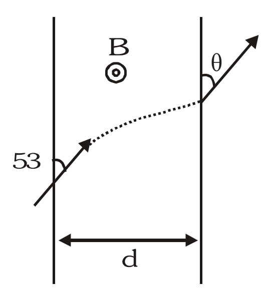
(A) $\left[\dfrac{vB}{2\pi E}\right]$ is an integer (B) $\left(u^2+v^2\right)^{1/2}\left[\dfrac{B}{\pi E}\right]$ is an integer(C) $\left[\dfrac{vB}{\pi E}\right]$ in an integer (D) $\left[\dfrac{uB}{\pi E}\right]$ is an integer

55. A particle having charge q enters a region of uniform magnetic field $\vec{B}$ (directed inwards) and is deflected a distance x after travelling a distance y. The magnitude of the momentum of the particle is



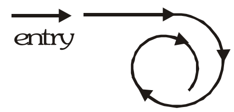
(A) $\dfrac{qBy}{2}$ (B) $\dfrac{qBy}{x}$ (C) $\dfrac{qB}{2}\left(\dfrac{y^2}{x}+x\right)$ (D) $\dfrac{qBy^2}{2x}$

56. A particle moving with velocity v having specific charge (q/m) enters a region of magnetic field B having width $d=\dfrac{3mv}{5qB}$ at angle 53 to the boundary of magnetic field. Find the angle θ in the diagram.



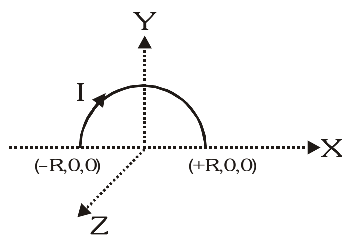
(A) 37^{0} (B) 60 (C) 90 (D) None

57. A charged particle enters a uniform magnetic field perpendicular to its initial direction travelling in air. The path of the particle is seen to follow the path in figure. Which of statements 1–3 is /are correct?
(1) The magnetic field strength may have been increased while the particle was travelling in air
(2) The particle lost energy by ionising the air
(3) The particle lost charge by ionising the air



(A) 1, 2, 3 are correct
(B) 1, 2 only are correct
(C) 2, 3 only are correct
(D) 1 only

58. A semi circular current carrying wire having radius R is placed in x–y plane with its centre at origin 'O'. There is non–uniform magnetic field $\vec{B} = \frac{B_0 x}{2R}\tilde{k}$ (here B_0 is +ve constant) is existing in the region. The magnetic force acting on semi circular wire will be along



(A) –x axis
(B) +y–axis
(C) –y axis
(D) +x–axis

ANSWER KEY LEVEL1																				
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	D	D	D	AD	BD	ABC	B	B	BC	D	C	C	ABC	ABC	ABD	AC	A	B	C	A
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	D	D	B	B	AB	A	C	D	ABCD	B	D	AB	BC	ABC	BC	AD	CD	D	C	A
Que.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58		
Ans.	D	C	C,D	B	D	A	A	B	A	A,D	A	C	D	C	C	C	B	A		