PHYSICS

BOOKS - DC PANDEY ENGLISH

MAGNETIC EFFECT OF CURRENT AND MAGNETISM

For Jee Main

1. A point charge is moving in clockwise direction in a circle with constant speed.

Consider the magnetic field produced by the charge at a fiexed point P (not at the centre of circle) on the axis of the circle. Then,

A. it is constant in magnitude only

B. it is a constant in direction only

C. it is constant in direction and magnitude and magnitude both

D. it is not constant in magnitude and direction both

Answer: A

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2. Which of the following particles will describe wll experience maximum magnetic force(magnitude) when projected with the same velocity perpendicular to a magnetic field?

A. Electron

B. Proton

C. He^{+}

D. Li^{++}

Answer: D

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3. An electron is projected with velocity v_0 in a unifrom electric field E perpendicular to the field Again it is projectced with velocity v_0 perpendicular to a unifrom 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. $\frac{Bv(2)o}{E}$

B. $\frac{B}{E}$

C. $\frac{Evo}{B}$

D. $\frac{Bvo}{E}$

Answer: D

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4. An electron having kinetic energy K is moving i a circular orbit of radius R perpendicular to a uniform magnetic induction. If kinetic energy is douled and magnetic induction tripled, the radius will become

A. $\frac{3R}{2}$

B. $\frac{\sqrt{3}}{2}R$

C. $\frac{\sqrt{2}}{3}R$

D. $\frac{\sqrt{4}}{3}R$

Answer: C

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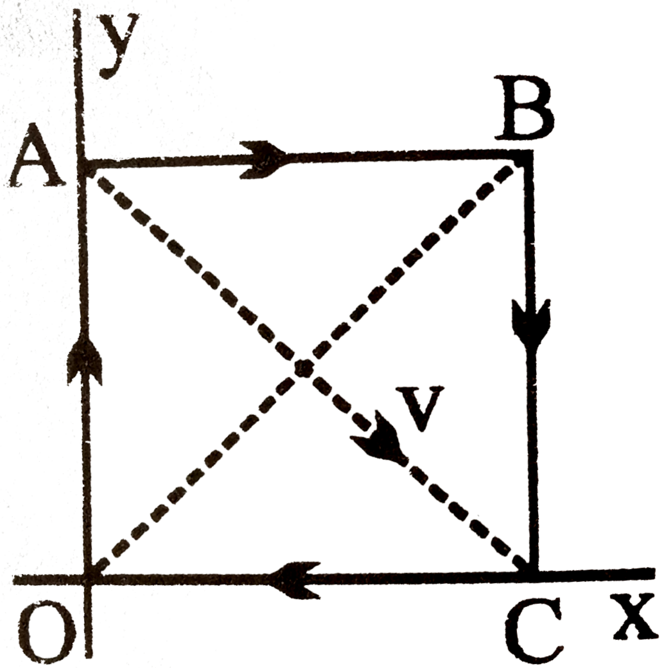
5. $OABC$ is a current carrying square loop an electron is projected from the center of loop along its diagonal AC as shown. Unit vector in the direction of initial acceleration will be



A. $\widehat{K}$

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

C. $-\widehat{K}$

D. $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

Answer: B

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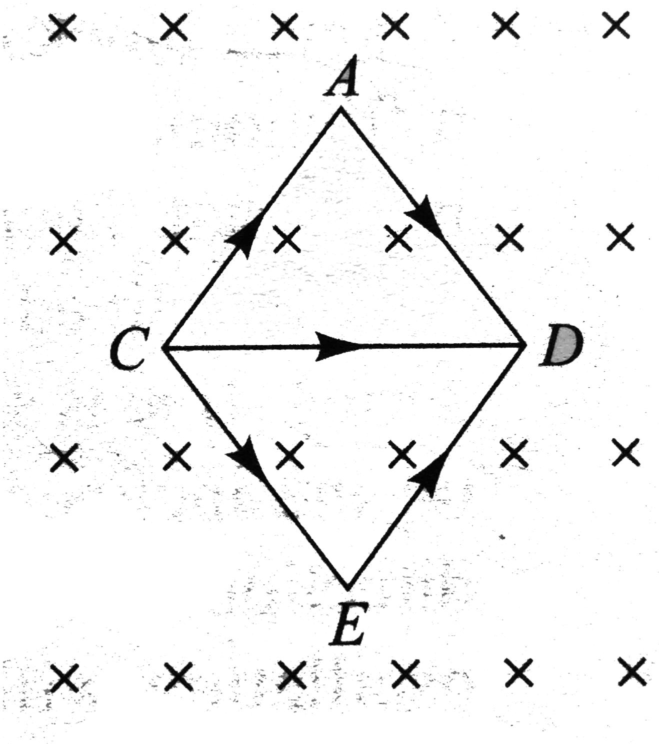
6. Let current $i = 2A$ be flowing in each part of a wire frame as shown in Fig. 1.138. The frame is a combination of two equilateral triangles ACD and CDE of side 1 m. It is placed in uniform magnetic field $B = 4T$ acting perpendicular to the plane of frame. The magnitude of magnetic force acting on the frame is



The pithc of the helical path followed by the particle is p. The radius of the helix will be

A. 24 N

B. zero

C. 16 N

D. 8 N

Answer: A

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7. A copper wire of diameter 1.6 mm carries a current of 20A. Find the maximum magnitude of the magnetic field $\left(\overrightarrow{B}\right)$ due to this current.

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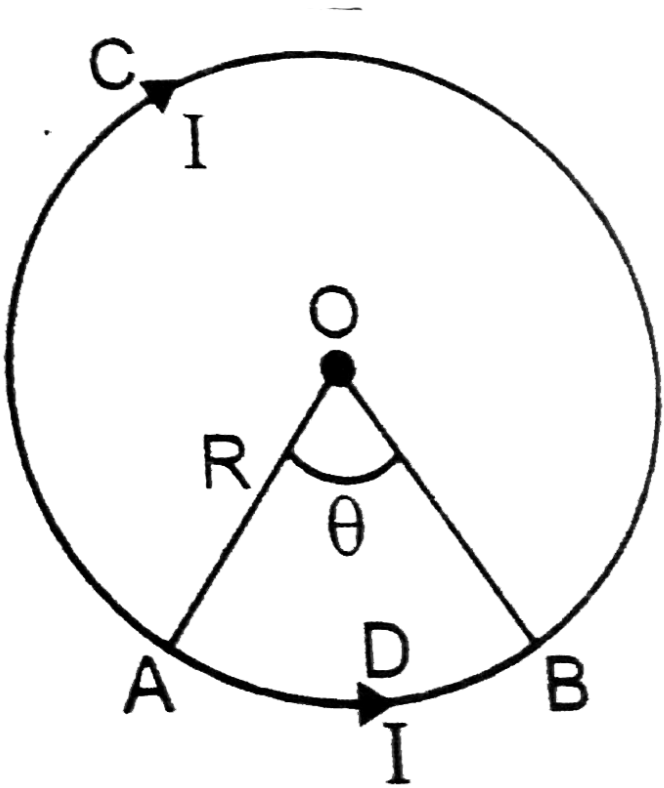
8. Equal current I flows in two segments of a circular loop in the direction shown in figure. Radius of loop is R. What is the magnitude of magnetic field induciton at the centre of the loop?



A. zero

B. $\left(\frac{\pi-\theta}{\pi}\frac{\mu o i}{2a}\right)$

C. $\left(\frac{2\pi-theat}{\pi}\right)\frac{\mu o i}{2a}$

D. $\left(\frac{\theta}{2\pi}\right)\frac{\mu o i}{2a}$

Answer: B

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9. An electron is moving along positive x-axis A unifrom electric field exists towards negative y-axis. What should be the direction of magnetic field of suitable magnitude so that net force of electrons is zero .

A. positive z- axis

B. negative z-axis

C. positive y-axis

D. negative y-axis

Answer: B

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10. A charged particle enters a unifrom magnetic field with velocity vector at an angle of 45° with the magnetic field . The pitch of the helical path followed by the particles is ρ .

The radius of the helix will be

A. $\frac{p}{\sqrt{2\pi}}$

B. $\sqrt{2}P$

C. $\frac{p}{2\pi}$

D. $\frac{\sqrt{2p}}{\pi}$

Answer: C

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11. Ratio of magnetic field at the centre of a current carrying coil of radius R and at a distance of $3R$ on its axis is

A. $10\sqrt{10}$

B. $20\sqrt{10}$

C. $2\sqrt{10}$

D. $\sqrt{10}$

Answer: A

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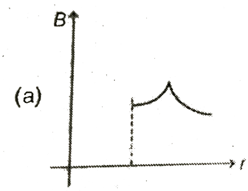
12. A current i is uniformly distributed over the cross section of a long hollow cylinderical wire of inner radius R_1 and outer radius R_2. Magnetic field B varies with distance r form the axis of the cylinder is

A. 

B.

C.

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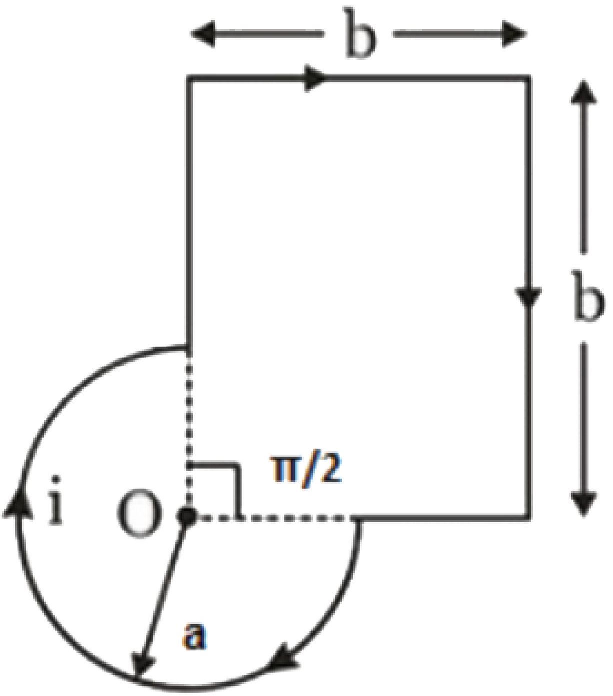
13. The magnitude of the magnetic field at O (centre of the circular part) due to the current - carrying coil as shown is :



A. zero

B. perpendicular to paper inwards

C. perpendiculr to paper outwards

D. is perpendicular to paper inwardsd if $\theta \pm 90^\circ$ and perpendicualr to paper outwards if $90^\circ \pm \theta \pm 180^\circ$

Answer: B

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14. Magnetic field at the centre of a circualr loop of area A carrying current I is B. What is the magnetic moment of this loop?

A. $\frac{BA^2}{\mu_0 \pi}$

B. $\frac{BA}{\mu_0}\sqrt{A}$

C. $\frac{2BA\sqrt{A}\sqrt{\pi}}{\mu_0}$

D. $\frac{2BA}{\mu_0}\sqrt{\frac{A}{\pi}}$

Answer: D

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15. A uniform magnetic field $\overline{B} = B_0 \hat{j}$ 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. $\frac{Bqd}{2m}$

Answer: D

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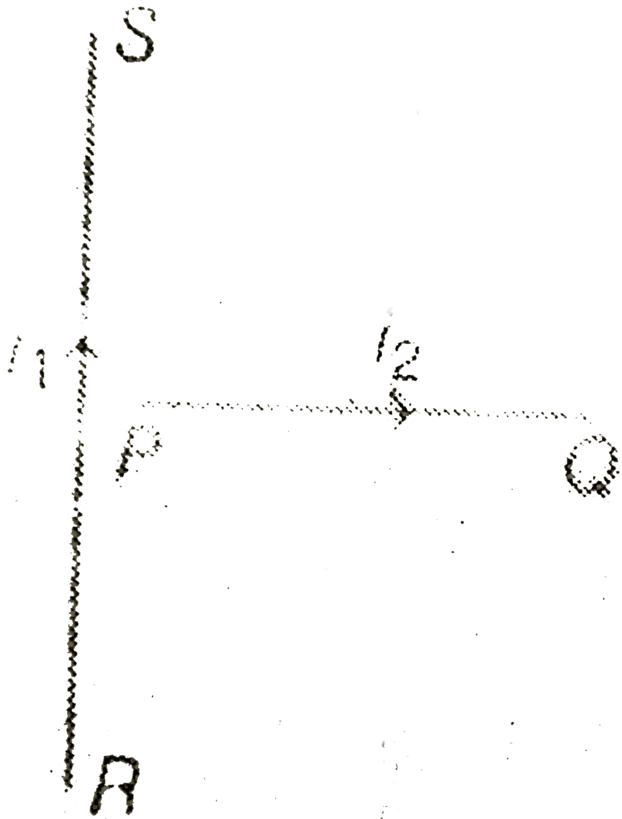
16. A current carrying wire PQ is placed near an another long current carrying wire RS . If free to move , wire PQ will be have



A. translational motion only

B. rotational motion only

C. transitational as well as rotationakl

D. neither translational nor rotational motion

Answer: C

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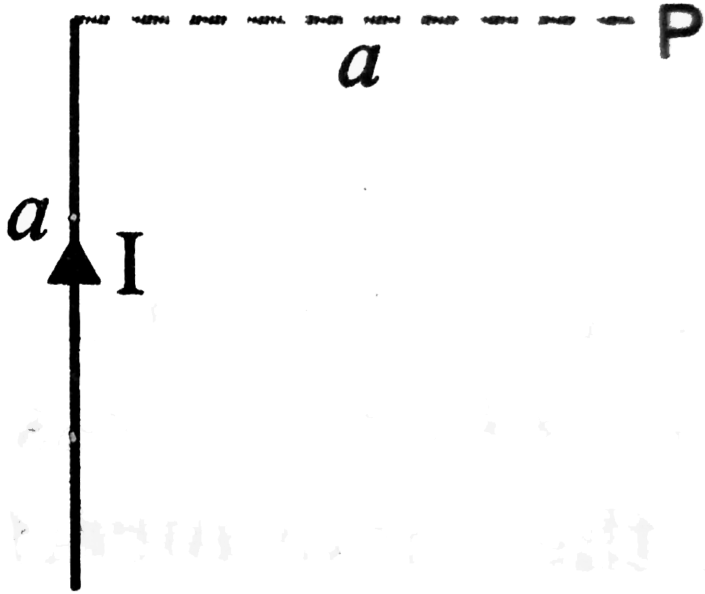
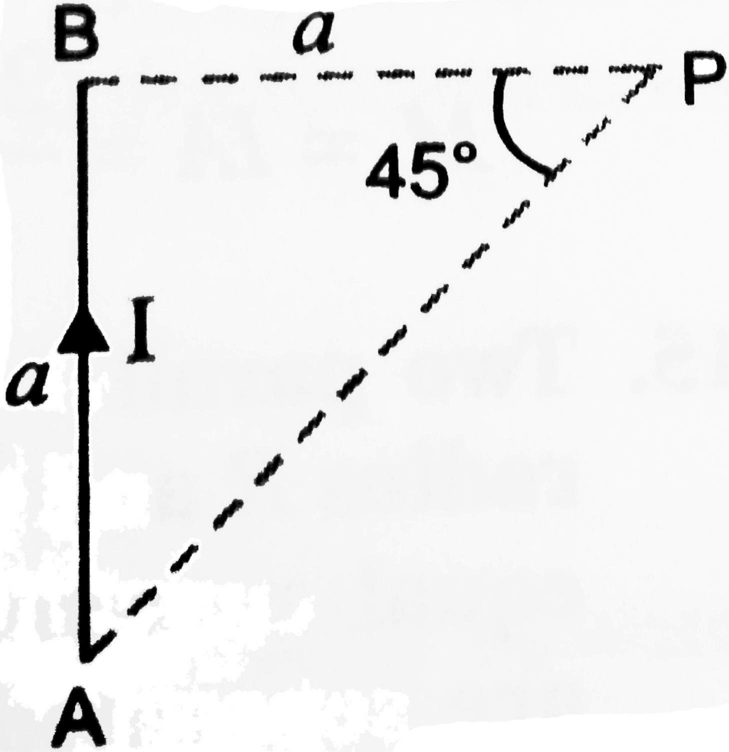
17. Figure shows a straight wire of length a carrying a current I. What is the magnitude of magnetic field induction produced by the current at P, which is lying at a perpendicular distance a from one end of the wire.



a
P
a
I



B
a
P
45°
I
a
A

A. $\frac{\sqrt{2\mu_0 i}}{\pi i}$

B. $\frac{\mu_0 i}{4\pi i}$

C. $\frac{\sqrt{2\mu_0 i}}{8\pi a}$

D. $\frac{\mu_0 i}{2\sqrt{2}\pi a}$

Answer: C

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18. A nonconducing disc of radius R is rotaing about axis passing through its cente and perpendicual its plance with an agular velocity ω

. The magnt moment of this disc is .

A. $\frac{1}{4}q\omega R^2$

B. $\frac{1}{2}q\omega R$

C. $q\omega R$

D. $\frac{1}{2}q\omega R^2$

Answer: A

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19. A metallic wire is folded to form a square loop a side $'a'$. It carries a current $'I'$ and is kept perpendicular to a uniform magnetic field. If the shape of the loop is changed from square to a circle without changing the length of thw wire and current, the amount of work done in doing so is

A. $iBa^2(\pi + 2)$

B. $iBa^2(\pi - 2)$

C. $iBa^2(4/\pi - 1)$

D. $iBa^2\left(1-\frac{4}{\pi}\right)$

Answer: D

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20. A wire of length l is bent in the form a circular coil of some turns. A current I flows through the coil. The coil is placed in a uniform magnetic field B. The maximum torqur on the coil can be

A. $\frac{iBl^2}{4\pi}$

B. $\frac{iBl^2}{\pi}$

C. $\frac{iBl^2}{2\pi}$

D. $\frac{2iBl^2}{\pi}$

Answer: A

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21. A charged particle enters a magnetic field at right angles to the field. The field exists for a length equal to 1.5 times the radius of circular path of particle. The particle will be deviated from its path by

A. 90°

B. $\sin^{-1}(2/3)$

C. 30°

D. 180°

Answer: D

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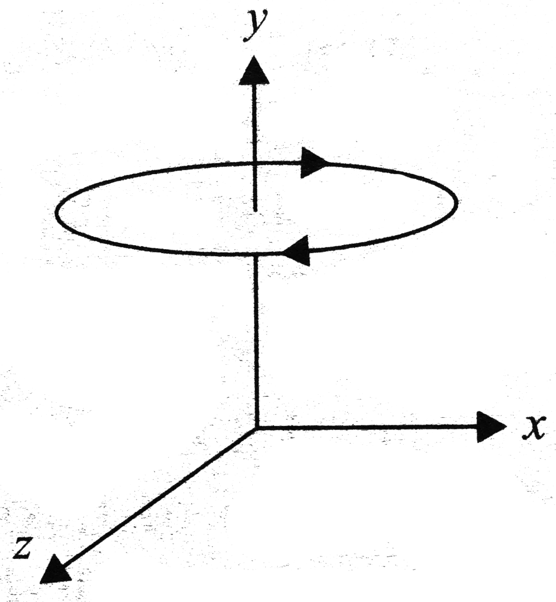
22. A circular coil having mass m is kept above ground (x-z plane) at some height. The coil carries i in the direction shown in Fig. 1.143. In which direction a uniform magnetic field $\overrightarrow{B}$ be applied so that the magnetic force balances the weight of the coil?



A. positive x-direction

B. negative x-direction

C. positive z-direction

D. None of these

Answer: D

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23. The magnetic field at the centre of an equilateral triangular loop of side 2L and carrying a current i is

A. $\frac{9\mu_0 i}{4\pi L}$

B. $\frac{3\sqrt{3\mu_0 i}}{4\pi L}$

C. $\frac{2\sqrt{3\mu_0 i}}{\pi L}$

D. $\frac{3\mu_0 i}{4\pi L}$

Answer: A

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24. A charge q moves with a velocity $2m/s$ along x- axis in a unifrom magnetic field

$B = \left(\hat{i} + 2\hat{j} + 3\hat{k}\right)$ tesla.

A. Charge will experience a force in z-y plane

B. Charge will experience a force along- y aixs

C. Charge will experience a force + z aixs

D. Charge will experience a force along - z axis

Answer: A

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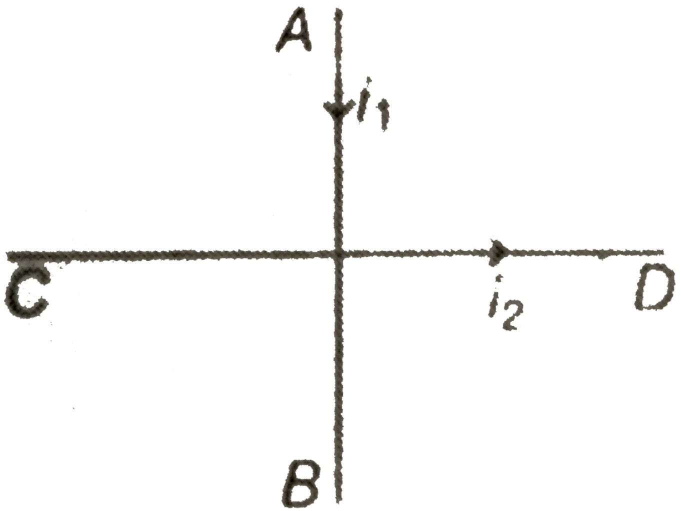
25. Two long wire AB abd CD carry currents i_1 and i_2 in the direactions show in figure



A. Force on wire AB is towards left

B. Force on wire AB is towards right

C. Torque on wire AB is clockwise

D. Torque on wire AB is anticlockwise

Answer: D

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26. Two parallel wire carrying equal currents in opposite directions are placed at $x = \pm a$ parralel to y-axis with $z = 0$. Magnetic field at origin O is B_1 and at $P(2a, 0, 0) is B_2$. Then, the ratio B_1 / B_2 is

A. -3

B. $-\frac{1}{2}$

C. $-\frac{1}{3}$

D. 2

Answer: A

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27. The ratio of the magnetic field at the centre of a current carrying circular coil to its magnetic moment is x. If the current and radius both are doubled the new ratio will become

A. $2x$

B. $4x$

C. $x / 4$

D. $x / 8$

Answer: D

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28. A magnetic needle is kept in a non uniform magnetic field . It experiences

A. a force and a torque

B. a force but not a troque

C. a torque but not a force

D. neither a force nor a torque

Answer: A

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29. Two thin long parallel wires seperated by a distance 'b' are carrying a current ' I' amp each .

The magnitude of the force3 per unit length exerted by one wire on the other is

A. $\frac{\mu_0 i^2}{b^2}$

B. $\frac{\mu_0 i^2}{2\pi b^2}$

C. $\frac{\mu_0 i^2}{2\pi b}$

D. $\frac{\mu_0 i}{2\pi b^2}$

Answer: C

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30. A long wire carrying a current $i = 2A$ is bent at right angles . The magnetic field lying on a perpendicular normal to the plane of the wire draw through the point of bending at distance 1 m form it is ....Tesla.

A. 2×10^{-7}

B. $4\sqrt{2} \times 10^{-7}$

C. $\sqrt{2} \times 10^{-7}$

D. $2\sqrt{2} \times 10^{-7}$

Answer: D

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31. A charge q is unifomly distrybuted over a nonconducting ring of radius R. The ring is rotated about an axis passing through its centre and perpendicular to the plane of the ring with frequency f. The ratio of electric potential to the magnetic field at the centre of the ring depends on.

A. $q, f, \text{ and } R$

B. $q \text{ and } fonly$

C. f and R

D. f

Answer: D

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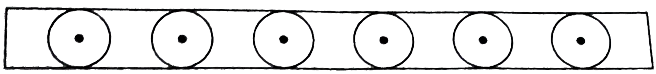
32. A large metal sheet carries an electric current along its surface. Current per unit length is λ.



Magnetic field induction near the metal sheet is

A. $\frac{\mu_0 \lambda}{2}$

B. $\frac{\lambda \mu_0}{2\pi}$

C. $\lambda \mu_0$

D. $\frac{\mu_0}{2\lambda\pi}$

Answer: A

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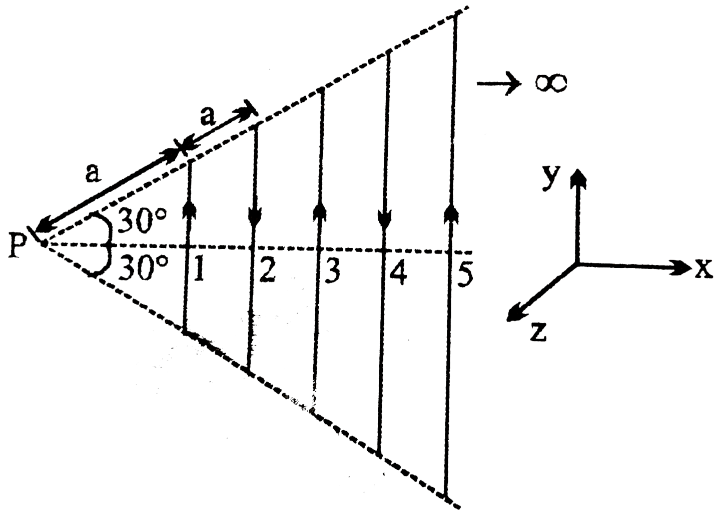
33. Infinite number of straight wires each carrying current I are equally placed as shown in the figure Adjacent wires have current in opposite direction Net magnetic field at point P

is



.

A. $\dfrac{\mu_0 lIn2}{4\pi\sqrt{3a}}\widehat{K}$

B. $\dfrac{\mu_0 lIn4}{4\pi\sqrt{3a}}\widehat{K}$

C. $\dfrac{\mu_0 lIn4}{4\pi\sqrt{3a}}\left(-\widehat{K}\right)$

D. zero

Answer: D

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34. A current I is flowing in a straight conductor of length L. The magnetic induction at a point distant $\frac{L}{4}$ from its centre will be

A. zero

B. $2\pi BaI\cos\theta$

C. $2\pi BaI\sin\theta$

D. None of these

Answer: C

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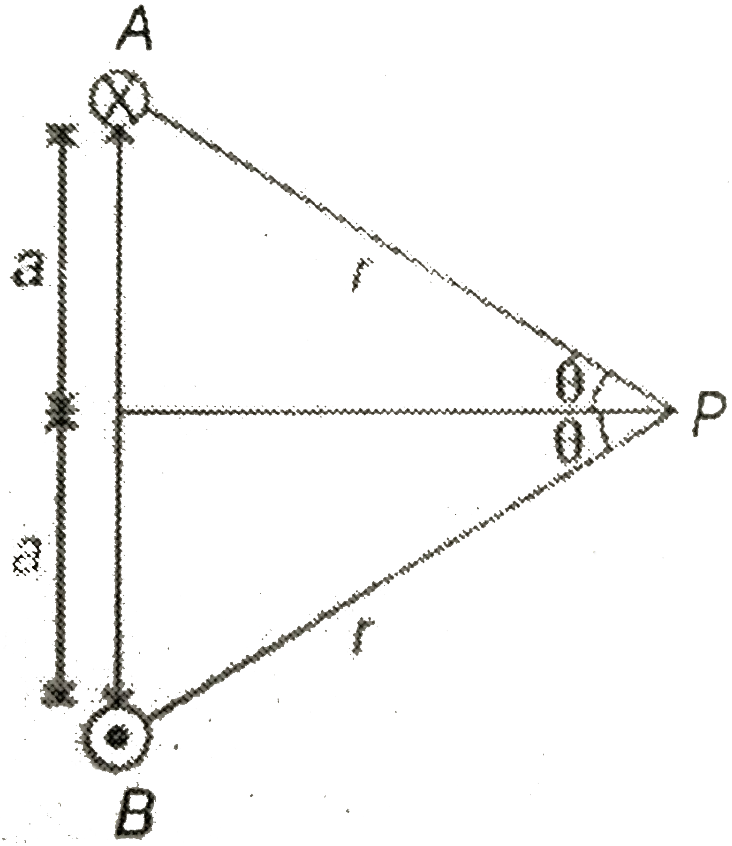
35. Two long parallel wire A and B situated perpendiculiar to the plane of the paper at a distance $2a$ are carrying equal currents I in opposite direction as show in the figure . The value of magnetic induction at point P situated at equal distance r from both the wires will be



A. $\dfrac{\mu_0 Ia}{4\pi r^2}$

B. $\dfrac{\mu_0 Ia}{2\pi r^2}$

C. $\dfrac{\mu_0 Ia}{\pi r^2}$

D. $\frac{\mu_0 la\sqrt{r^2 - a^2}}{\pi r^2}$

Answer: C

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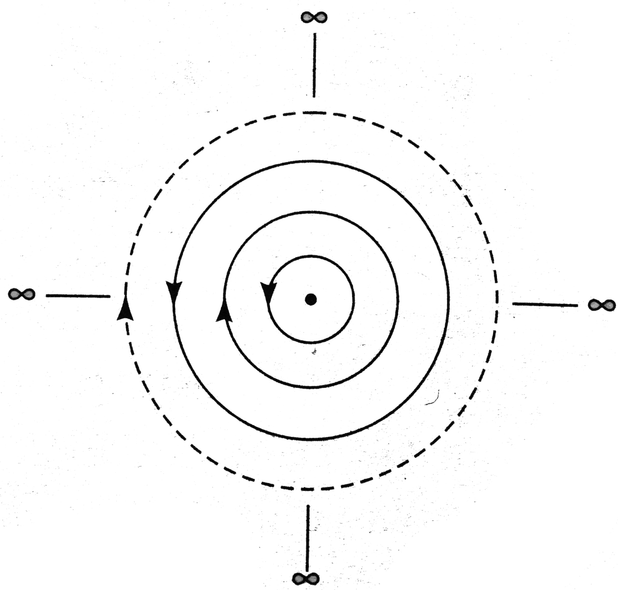
36. In Fig. infinite conducting rings each having current i in the direciton shown are placed concentrically in the same plane as shown in the figure. The radii of rings are $r, 2r, 2^2 r, 2^3 r, \ldots\ldots, (\infty)$. The magnetic field at the centre of rings will be



A. zero

B. $\frac{\mu_0 i}{r}$

C. $\frac{\mu_0 i}{2r}$

D. $\frac{\mu_0 i}{3r}$

Answer: D

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37. The figure shows a long striaght wire of a circular cross-section (radius a) carrying steady current I.The current I is unifromly distributed across this distance $a/2$ and 2a from axis is

A. $2:1$

B. $1:2$

C. $4:1$

D. $1:1$

Answer: D

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38. It is known from Curie's law that magnetic moment (m) of a paramagnetic sample is directly proporational to the ratio of the external magnetic field (B) to the absolute temperature (T). A sample of paramagnetic salt contains 2.0×10^{24} atomic dipoles each of dipole moment $1.5 \times 10^{-23} JT^{-1}$.

Sample is placed under a homogeneous magnetic field of $0.84T$ and cooled to a temperature of 4.2. The drgree of magnetic saturation achevied is equal to 15% . You may assume that 85% dipoles are randomly oriented and do not contributes to the magnetisation . The total diploe moment of the sample , for a magnetic field of $0.98T$ and a temperature of $2.8K$, is

A. $4.5J/T$

B. $30J/T$

C. $7.9J/T$

D. $3J/T$

Answer: C

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39. A paramagnetic sample shows a net magnetisation of $8Am^{-1}$ when placed in an external magnetic field of $0 \cdot 6T$ at a temperature of $4K$. When the same sample is placed in an external magnetic field of $0 \cdot 2T$ at a temperature of $16K$, the magnetisation will be

A. $\frac{32}{3} Am^{-1}$

B. $\frac{2}{3} Am^{-1}$

C. $6 Am^{-1}$

D. $2.4 Am^{-1}$

Answer: B

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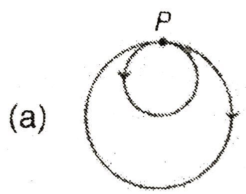
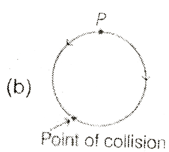
40. A neutral particle at rest in a magnetic field decays into two charged particles of different mass. The energy released goes into their kinetic energy. Then what can be the path of the particles. Neglect any interaction between the two charges.

A. 

B. 

C.

D.

Answer: B

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41. Every iron atom in a ferromagnetic domain has a magnetic dipole moment equal to $9.27 \times 10^{-24} Am^2$. A ferromagetic domain in iron has the shape of a cube of side $1 \mu m$. The maximum dipole moment occurs when all the dipoles are alligned. The molar mass of uiron is

55 g and its specific gravity is 7.9 .The magnetisation of the domain is .

A. $8.0 \times 10^5 A/m$

B. $8.0 \times 10^8 A/m$

C. $8.0 \times 10^{11} A/m$

D. $8.0 \times 10^{14} A/m$

Answer: A

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42. A circular coil of radius 5π cm having a total of the magnetic meridian plane (i.e. the vertical plane in the north-south direction) . It is rotated about its vertical diameter by 45° and a current of $\sqrt{2A}$ is passed through it. A magnetic needle placed at the centre of this coil points west to east. The horizontalcopmonent of the earth's magnetic field is

A. $20 \times 10^{-5} T$

B. $4 \times 10^{-5} T$

C. $4 \times 10^{-7} T$

D. $\frac{4}{\pi} \times 10^{-5} T$

Answer: B

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43. A sample of paramagnetic salt contains 2×10^{24} atomic dipoles, each of moment $1.5 \times 10^{-23} JT^{-1}$. The sample is placed under a homogeneous magnetic field of $0.64T$ and cooled to a temperature of $4.2K$. The degree of magnetic saturation archieved is equal to 15%.

What is the total dipole moment of the sample for a mangetic field of $0.98T$ and a temperature of $2.8K$. (Assume Curie's law).

A. $8 \times 10^{3} J / T$

B. $10.34 J / T$

C. $8 \times 10^{-3} J / T$

D. $25 J / T$

Answer: B

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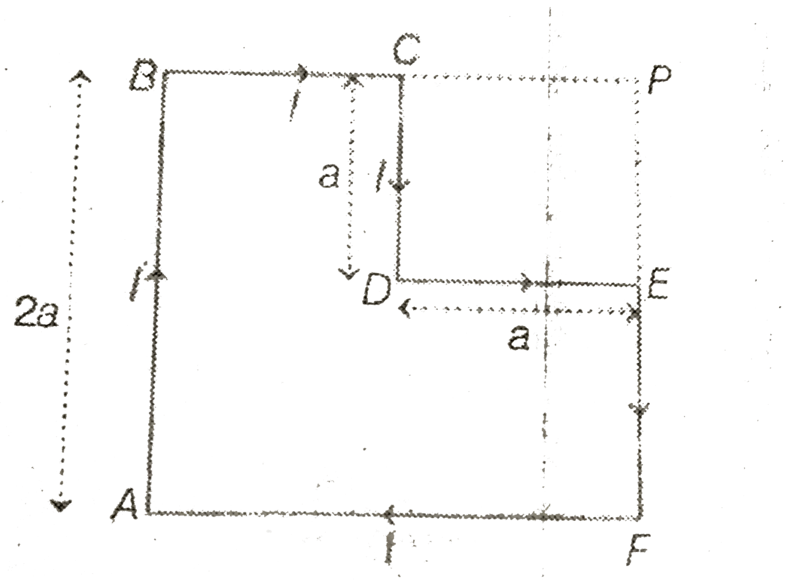
44. In the shown arrangement magentic field at P is :



A. zero

B. $\frac{\mu_0 l}{2\sqrt{2}\pi a}$

C. $\frac{\mu_0 l}{\sqrt{2}\pi a}$

D. $\frac{\mu_0 l}{4\sqrt{2}\pi a}$

Answer: D

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45. A measurement of the horizatal component $B\_(H)$ of the Earth's field at the location of Tuscon, Arizona, gave a value of $26\mu T$. By suspending a small magent like a compass that is free to swing in a vertical plante ,it is possible to measure the angle between the field direction and the horizontal plane, called the inclination or the dip angle ϕ .The dip angle at Tucson was measured to be 60° . Find teh magnitude at taht location .

A. 52 u T

B. 26sqrt(3)uT`

C. 26sqrt(2)muT`

D. 26 uT

Answer: B

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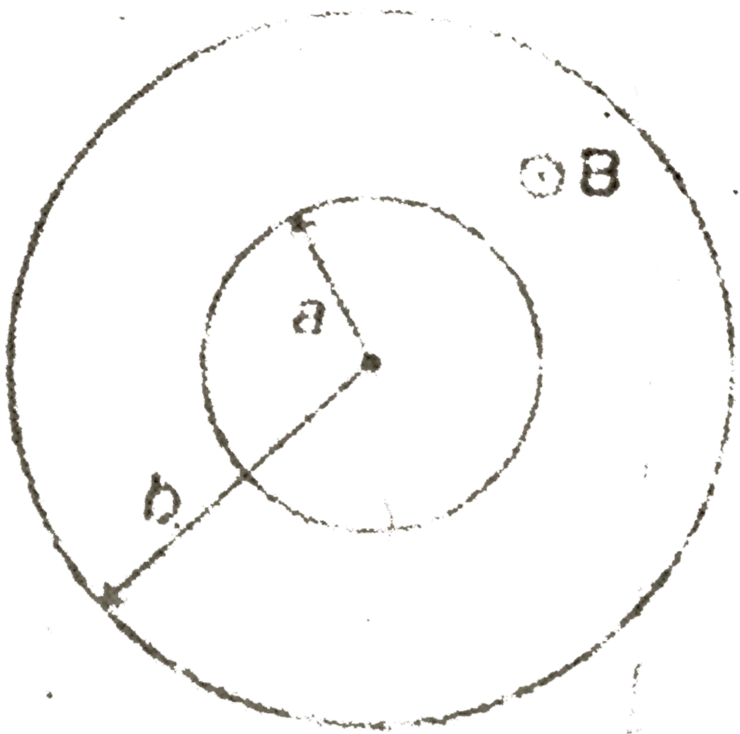
46. A unifrom magnetic field B existis in the space between two coaxial cylinders of radius 'a' and 'b' respectivelly. The direction of magnetic field is parallel to the axis of the cylinder a shown in figure . A negatively charged particle of change -q and mass m is projected from teh outer surface of inner cyclinder with an initial velocity v_0 in the radialy outward direction . The minimum value to of magnetic field so that the particle does not hit the surface of the outer cyclinder is



A. $\dfrac{mv_0}{2q(b-a)}$

B. $\dfrac{2mv_0b}{q(b^2-a^2)}$

C. $\dfrac{2mv_0}{q\sqrt{b^2-a^2}}$

D. $\frac{2mv_0}{q(b+a)}$

Answer: B

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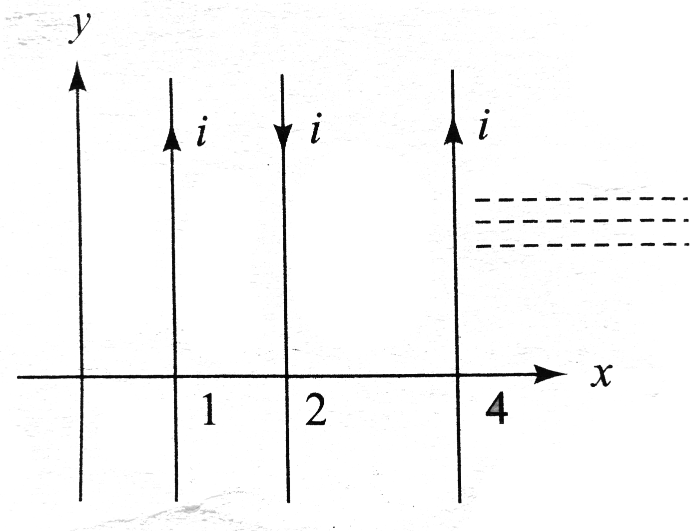
Only One Option Is Correct

1. Equal currents $i = 1$ A are flowing through the wires parallel to y-axis located at $x = +1m, x = +2m, x = +4m$ and so on...., etc. but in opposite directions as shown in

Fig The magnetic field (in tesla) at origin would be



A. $-1.33 \times 10^{-7}\widehat{K}$

B. $1.33 \times 10^{-7}\widehat{K}$

C. $2.67 \times 10^{7}\hat{k}$

D. $-2.67 \times 10^{7}\hat{k}$

Answer: B

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2. Same current i is flowing in the three infinitely long wires along positive x-,y- and z-directions. The magnetic filed at a point (0,0,-a) would be

A. $\frac{\mu_0 i}{2\pi a}\left(\hat{j}-\hat{i}\right)$

B. $\frac{\mu_0 i}{2\pi a}\left(\hat{i}+\hat{j}\right)$

C. $\frac{\mu_0 i}{2\pi a}\left(\hat{i}-\hat{j}\right)$

D. $\frac{\mu_0 i}{2\pi a}\left(\hat{i}-\hat{j}+\hat{k}\right)$

Answer: A

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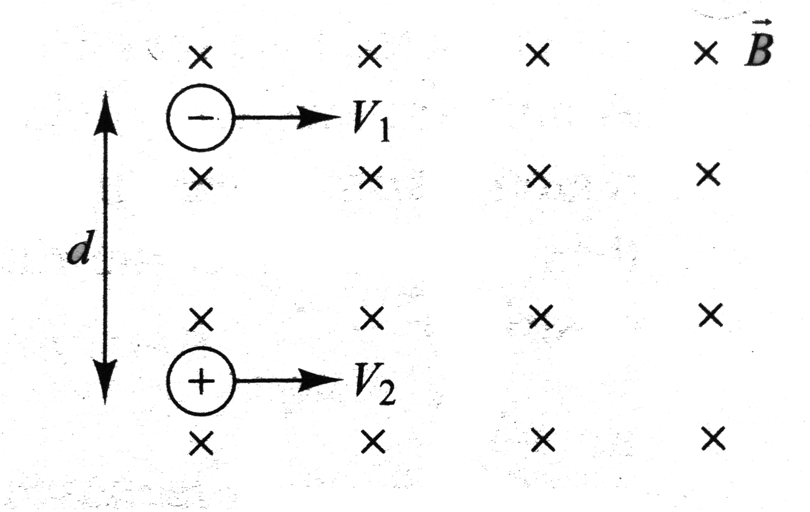
3. Two identical particles having the same mass m and charges +q and -q separated by a distance d enter a uniform magnetic field B directed perpendicular to paper inwards with speeds v_1 and v_2 as shown in Fig. 1.139. The particles will not collide if



A. $d > \frac{m}{Bq}(V_1 + V_2)$

B. $d < \frac{m}{Bq}(V_1 + V_2)$

C. $d > \frac{2m}{Bq}(V_1 + V_2)$

D. $V_1 = V_2$

Answer: C

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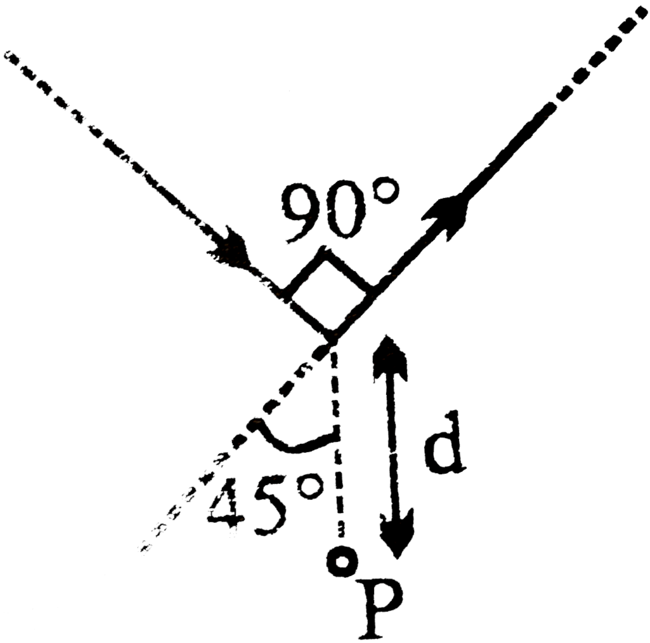
4. Find the magnetic field at P due to the arrangement shown



A. $\frac{\mu_0 i}{\sqrt{2\pi a}}\left(1-\frac{1}{\sqrt{2}}\right) \otimes$

B. $\frac{2\mu_0 i}{\sqrt{2\pi a}} \otimes$

C. $\frac{\mu_0 i}{\sqrt{2\pi a}} \otimes$

D. $\frac{\mu_0 i}{\sqrt{2\pi a}}\left(1 + \frac{1}{\sqrt{2}}\right) \otimes$

Answer: A

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5. A wire of length 1 m placed in x-z plane carries current of 1 amp. The coefficient of friction between wire and the surface is 0.2 and mass of the wire is 2. The magnetic field of strengh 2 T exists along position y direction . Then choose the correct statment .

A. Acceleration of wire is $0.5m/s^2$

B. Wire will not move at all

C. Accceleration of wire is m/s^2

D. Acceleration of wire is $2m/s^2$

Answer: B

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6. A charge particle having charge q expericenec a $F_1q = \left(-\hat{j} + \hat{k}\right)N$ in a magnetic field B when is has velocity $v_1 = (1.0)\hat{i}\frac{m}{s}$. The force becomes $F = q\left(\hat{i} - \hat{k}\right)$ when the velocity is charged to $v_2 = 1.0\hat{j}\frac{m}{s}$ magnetic induction vector at that point is

A. $\left(\hat{i} + \hat{j} + \hat{k}\right)T$

B. $\left(\hat{i} - \hat{j} - \hat{k}\right)T$

C. $\left(-\hat{i} - \hat{j} + \hat{k}\right)T$

D. $\left(\hat{i} + \hat{j} - \hat{k}\right)T$

Answer: A

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7. A change particule is projected with velocity v_0 at positive x-axis .The magnetic field B is direction s negative z-aixs between $x = 0$ and $x = l$. The particule emerges out (at x =L) at an angle of 60° with direction of projected (at x = 0) a positive x-axis. Find v so that when it emerges out (at x = L) the angle made by it is 30° with the direction projection

A. $2v_0$

B. $v_0 / 2$

C. $v_0 / \sqrt{3}$

D. $v_0 \sqrt{3}$

Answer: D

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8. The dimensions of $\frac{B^2 R^2 C^2}{2\mu_0}$ (Where B is magnetic filed, and μ_0 is permeability of free space , R resistance and C is capacitance) is

A. $[ML^{-1}]$

B. $[MLT^{-1}]$

C. $[ML^2T^{-1}]$

D. $[MLT^2]$

Answer: A

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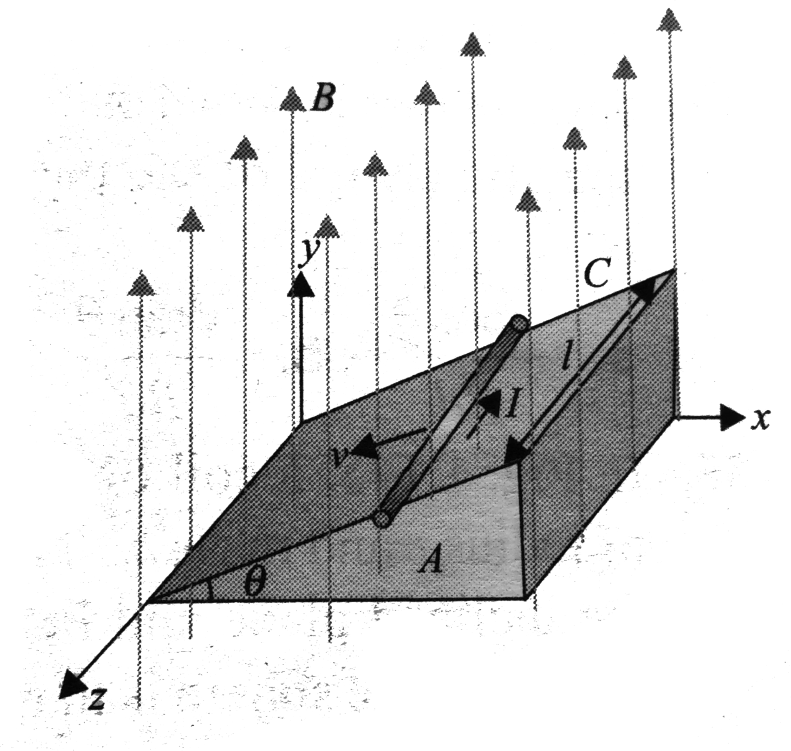
9. A conducting rod of length l and mass m is moving down a smooth inclined plane of inclination θ with constant i is flowing in the conductor in a direction perpendicular to paper inwards. A vertically upward magnetic field $\overrightarrow{B}$ exists in space. Then, magnitude of magnetic field $\overrightarrow{B}$ is



A. $\dfrac{mg}{il}\sin\theta$

B. $\dfrac{mg}{il}\tan\theta$

C. $\dfrac{mg\cos\theta}{il}$

D. $\frac{mg}{il \sin \theta}$

Answer: B

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10. A particle of mass m and charge q has and initial velocity $\overrightarrow{v} = v_0 \hat{j}$. If an electric field $\overrightarrow{E} = \overrightarrow{=}(0)\hat{i}$ and magnetic field $\overrightarrow{B} = B_0 \hat{i}$ act on the particle, its speed will double after a time

:

A. $t = \frac{2mv_0}{qE}$

B. $t = \frac{2Bq}{mv_0}$

C. $t = \frac{\sqrt{3}Bq}{mv_0}$

D. $t = \frac{\sqrt{3}mv_0}{qE}$

Answer: D

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11. A rigid circular loop of radius r and mass m lies in the $XY -$ plane of a flat table and has a current I flowing in it. At this particular place.

The Earth's magnetic field $\overrightarrow{B} = B_x i + B_z k$. The value of I so that the loop starts tilting is :

A. $\dfrac{mg}{\pi r\sqrt{B_x^2 + B_2^z}}$

B. $\dfrac{mg}{\pi r B_z}$

C. $\dfrac{mg}{\pi r B_x}$

D. $\dfrac{mg}{\pi r\sqrt{B_x B_z}}$

Answer: C

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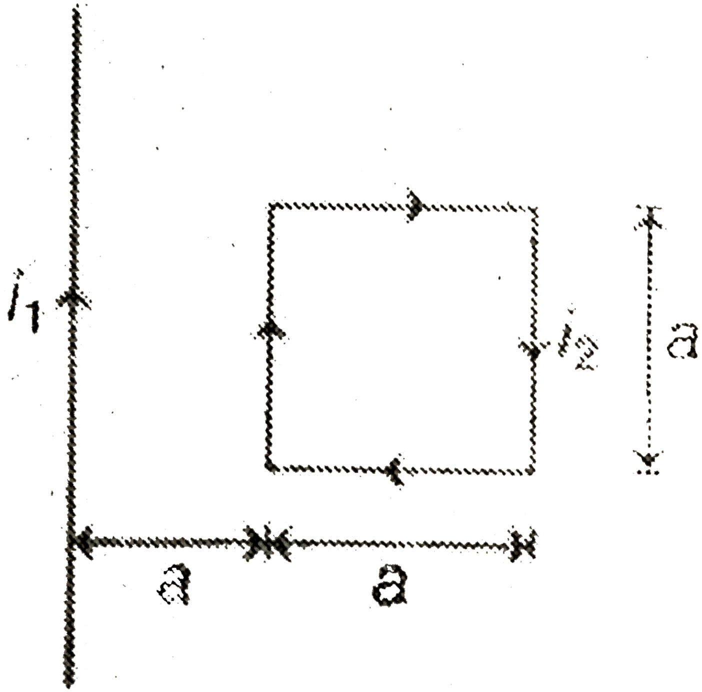
12. A current carrying squre loop is placed near an infinitely long current carrying wire as shown in figure . The loop torque acting on the loop is



A. $\frac{\mu_0}{2\pi}\left(\frac{i_1 i_2 a}{2}\right)$

B. $\frac{\mu_0 i_1 i_2 a}{2\pi}$

C. $\frac{\mu_0 i_1 i_2 a}{2\pi} In(2)$

D. Zero

Answer: D

Watch Video Solution

13. A conducting rod of mass m and length l is placed over a smooth horizontal surface. A uniform magnetic field B is acting perpendicular to the rod. Charge q is suddenly passed through the rod and it acquires an initial velocity v on the surface, then q is equal to

A. $\frac{2mv}{BI}$

B. $\frac{BI}{2mv}$

C. $\frac{mv}{BI}$

D. $\frac{BlV}{2m}$

Answer: C

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14. Choose the correct option:

A particle of charge per unit mass α is released from origin with a velocity $\overrightarrow{v} = v_0\hat{i}$ in a magnetic field

$\overrightarrow{B} = -B_0\hat{k}$ for $x \leq \frac{\sqrt{3}}{2}\frac{v_0}{B_0\alpha}$

and $\overrightarrow{B} = 0$ for $x > \frac{\sqrt{3}}{2}\frac{v_0}{B_0\alpha}$

The x-coordinate of the particle at time $t\left(\frac{\pi}{3B_0\alpha}\right)$ would be

A. (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. (b) $\frac{\sqrt{3}}{2}\frac{V_0}{B_0\alpha} + v_0\left(t - \frac{\pi}{B_0\alpha}\right)$

C. (c) $\frac{\sqrt{3}}{2}\frac{V_0}{B_0\alpha}+\frac{v_0}{2}\left(t-\frac{\pi}{B_0\alpha}\right)$

D. (d) $\frac{\sqrt{3}}{2}\frac{V_0}{B_0\alpha}+\frac{v_0 t}{2}$

Answer: C

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15. A particle of charge per unit mass α is released from the origin with velocity $v=v_0\hat{i}$ in the magnetic field $\overrightarrow{B}=-B_0\hat{k}$ for A cup of tea cools from $80^\circ C$ to $60^\circ C$ in 40 seconds. The ambient temperature is $30^\circ C$. In cooling from

$60^\circ C$ to $50^\circ C$, it will take time:

$$x \leq \frac{\sqrt{3}}{2}\frac{v_0}{B_0\alpha} \text{ and } \vec{B} = 0 \text{ for } x > \frac{\sqrt{3}}{2}\frac{v_0}{B_0\alpha}$$

The x - coordinate of the particle at time $t\left(> \frac{\pi}{3B_0\alpha}\right)$ would be

A. $-\frac{2V_0}{B_0\alpha}$

B. $-\frac{V_0}{B_0\alpha}$

C. $\frac{2V_0}{B_0\alpha}$

D. $-\frac{V_0}{B_0\alpha}$

Answer: C

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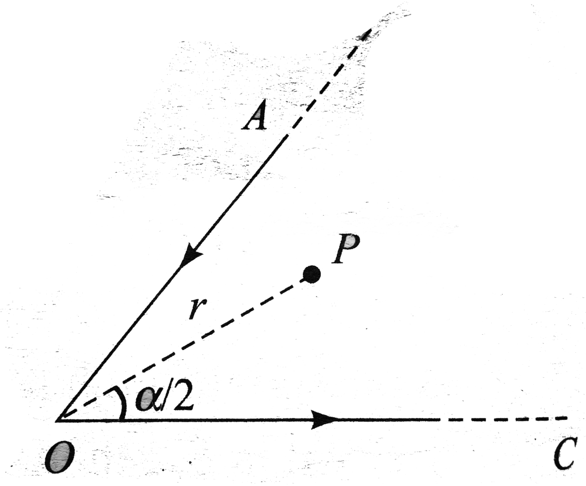
16. Two wires AO and OC carry equal currents i as shown in Fig. One end of both the wires extends to infinity. Angle AOC is α. The magnitude of magnetic field is point P on the bisector of these two wires at a distance r from point O is



A. $\frac{\mu_0}{2\pi}\frac{i}{r}\cot\left(\frac{\alpha}{2}\right)$

B. $\frac{\mu_0}{4\pi}\frac{i}{r}\cot\left(\frac{\alpha}{2}\right)$

C. $\frac{\mu_0}{2\pi}\frac{i}{r}\frac{\left(1+\frac{\cos\alpha}{2}\right)}{\sin\left(\frac{\alpha}{2}\right)}$

D. $\frac{\mu_0}{2\pi}\frac{i}{r}\sin\left(\frac{\alpha}{2}\right)$

Answer: A

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17. Choose the correct option:

Figure shows a square current carrying loop

$ABCD$ of side $2m$ and current$i = \frac{1}{2}A$. The magnetic moment $\overrightarrow{M}$ of the loop is

A. (a) $\left(\hat{i} - \sqrt{3\hat{k}}\right)A - m^2$

B. (b) $\left(\hat{i} - \hat{k}\right)A - m^2$

C. (c) $\left(\sqrt{3\hat{i}} + \hat{k}\right)A - m^2$

D. (d) $\left(\hat{i} + \hat{k}\right)A - m^2$

Answer: A

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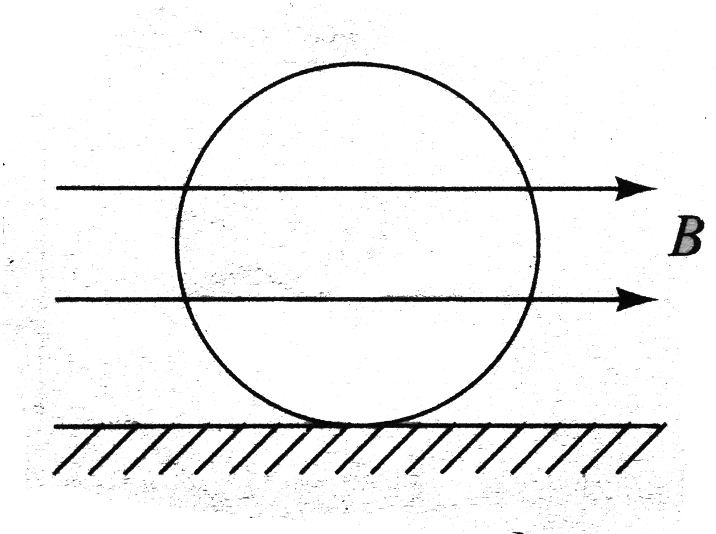
18. A conducting ring of mass 2kg and radius $0.5m$ is placed on a smooth plane. The ring carries a current of $i = 4A$. A horizontal magnetic field $B = 10T$ is switched on at time $t = 0$ as shown in fig The initial angular acceleration of the ring will be



A. $40\pi rad / s^2$

B. $20\pi rad / s^2$

C. $5\pi rad / s^2$

D. $15\pi rad / s^2$

Answer: D

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19. A charge praticule of sepeific charge (charge/ mass) α is realsed from origin at time t=0 with velocity $v = v_0\left(\hat{i} + \hat{j}\right)$ in unifrom magnetic fields $B = B_0\hat{i}$. Co-ordinaties of the particle at time $t = \dfrac{\pi}{B_0\alpha}$ are

A. $\left(\dfrac{V_0}{2B_0\alpha}, \dfrac{\sqrt{2V_0}}{\alpha B_0}, \dfrac{-V_0}{B_0\alpha}\right)$

B. $\left(\dfrac{-V_0}{B_0\alpha}, 0, 0\right)$

C. $\left(0, \dfrac{2V_0}{B_0\alpha}, \dfrac{V_0\pi}{2B_0\alpha}\right)$

D. $\left(\dfrac{V_0\pi}{2B_0\alpha}, 0, \dfrac{-2V_0}{B_0\alpha}\right)$

Answer: D

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20. Magnetic moment of an electron in nth orbit of hydrogen atom is

A. $\frac{\neq h}{\pi m}$

B. $\frac{\neq h}{4\pi m}$

C. $meh\frac{)}{2\pi n}$

D. $\frac{meh}{4\pi n}$

Answer: B

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21. Two very long straight parallel wires carry steady currents i and $2i$ in opposite directions. The distance between the wires is d. At a certain instant of time a point charge q is at a point equidistant from the two wires in the plane of the wires. Its instantaneous velocity $\vec{v}$ is perpendicular to this plane. The magnitude of the force due to the magnetic field acting on t he charge at this instant is

A. $\frac{\mu_0 i q v}{2\pi d}$

B. $\frac{\mu_0 i q v}{\pi d}$

C. $\frac{3\mu_0 iqv}{2\pi d}$

D. zero

Answer: D

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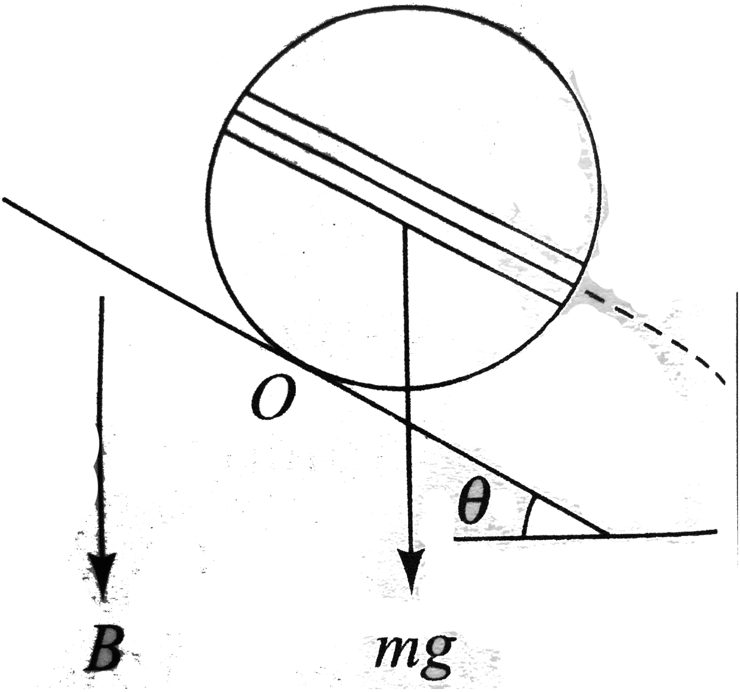
22. In Fig. a coil of single turn is wound on a sphere of radius r and mass m. The plane of the coil is parallel to the inclined plane and lies in the equatorial plane of the sphere. If the sphere is in rotational equilibrium, the value of B is

[Current in the coil is i]



A. $\dfrac{mg\cos\theta}{\pi iR}$

B. $\dfrac{mg}{\pi iR}$

C. $\dfrac{mg\tan\theta}{\pi iR}$

D. $\dfrac{mg\sin\theta}{\pi iR}$

Answer: B

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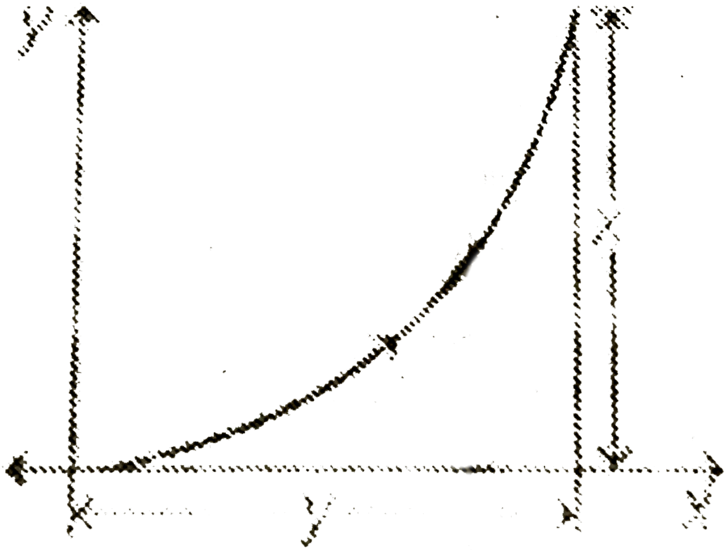
23. A particule having charge q enters a rection of untiormal magnetic field B (direction inwards) and in denfectro as shown . The magnetic of the momentum of the particles is



A. $\dfrac{qBy}{2}$

B. $\dfrac{qBy}{x}$

C. $\dfrac{qB}{2}\left(\dfrac{y^2}{x}+x\right)$

D. $\dfrac{qBy^2}{2x}$

Answer: C

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

A. $\dfrac{13}{2}\dfrac{\alpha E_0}{B_0}$

B. $\dfrac{16\alpha B_0}{E_0}$

C. $\frac{25}{2\alpha E_0}$

D. $\frac{5\alpha}{2B_0}$

Answer: B

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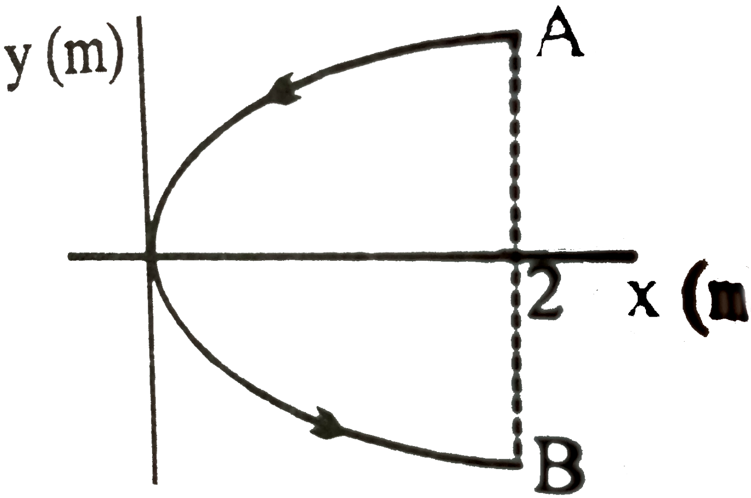
25. A conducting wire bent in the from of a parabola $y^2 = 2x$ carries a current $i = 2A$ as shown in figure This wire is placed in a unifrom magnetic field

$\overrightarrow{B} = -4\hat{k}$ Tesla The magnetic force on the wire is (newton)



A. $-16\hat{i}$

B. $32\hat{i}$

C. $-32\hat{i}$

D. $16\hat{i}$

Answer: B

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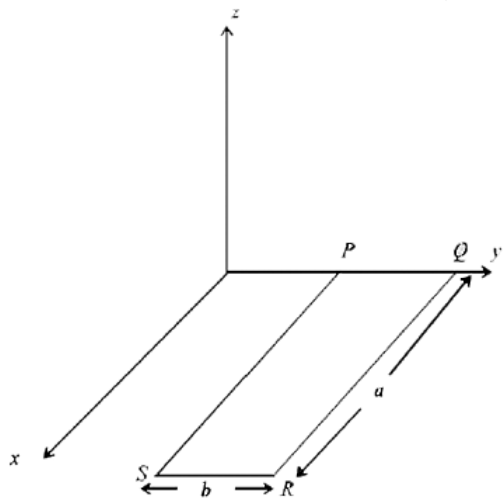
26. A rectangular loop PQRS made from a uniform wire has length a, width b and mass m. It is free to rotate about the arm PQ, which remains hinged along a horizontal line taken as the y-axis (see figure). Take the vertically upward direction as the z-axis. A uniform magnetic field $\overrightarrow{B} = \left(3\hat{i} + 4\hat{k}\right)B_0$ exists in the region. The loop is held in the x-y plane and a current I is passed through it. The loop is now released and is found to stay in the horizontal position in equilibrium



(a) What is the direction of the current I in PQ?

(b) Find the magnetic force on the arm RS.

(c) Find the expression for I in terms of B_0, a, b and m

A. along $+ za\xi s$

B. along $+ xa\xi s$

C. along $-zaixs$

D. along $-xa\xi s$

Answer: C

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27. A circular loop of radius R carrying a current I is placed in a uniform magnetic field B perpendicular to the loop. The force on the loop is

A. irB_0

B. $2\pi irB_0$

C. zero

D. πirB_0

Answer: c

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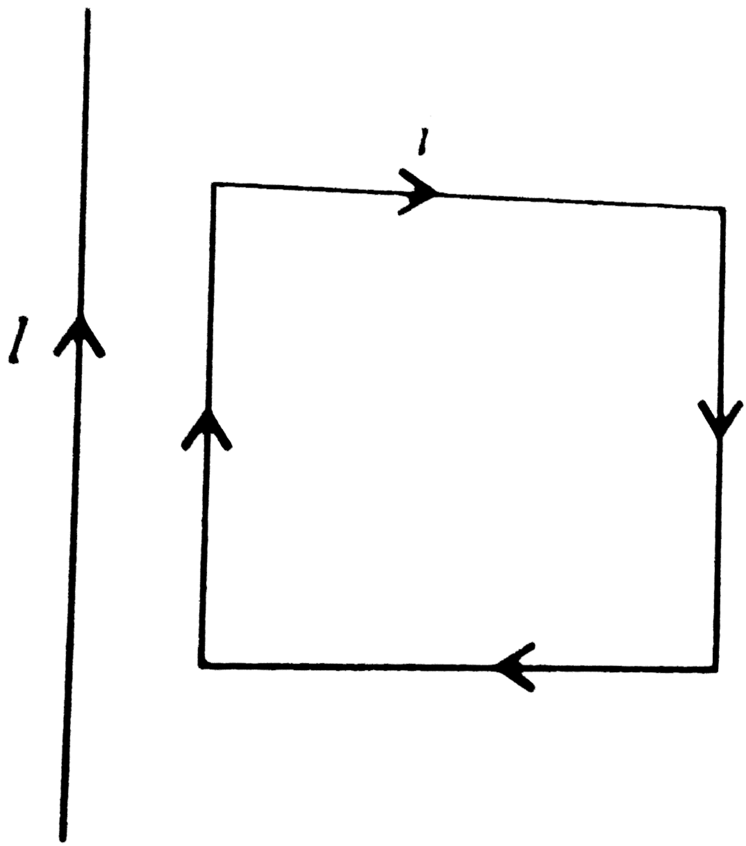
28. A rectanguar doop carrying a current I is situated near a long straight wire such that the wire is parallel to one of the sides of the loop. If a steady current I is established in the wire, as shown in figure, the loop will



A. rotate about an axis parallel to the wire

B. move away from the wire

C. move towards the wire

D. remain stationary

Answer: c

Watch Video Solution

29. Kinetic energy of a charged particle is zero at time t_0. K at time 2 t_0. 2K at time 3 t_0. It remains constant (i.e.2K) upto 4 t_0. Choose the correct option.

A. Only electric field is present between a time interval from t_0 to 2 t_0

B. No field is present between time interal from interval from 3 t_0 to 4 t_0

C. Both (a) and (b) are correct

D. Both (a) and (b) are wrong

Answer: d

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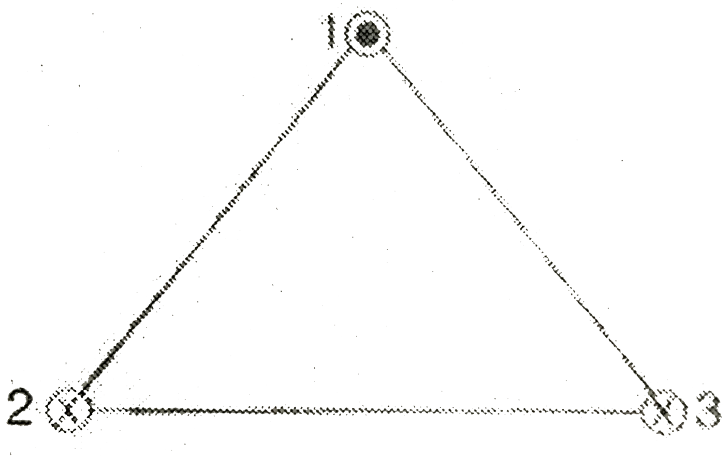
30. Three infinetely long wires 1 , 2 and 3 carry equal currents in the directions shown in fiugre. They are placed on the vertices of an equilateral triangle. Let F be the magnitude of force between any two wires.



F_1 is the magnitude of force on wire 1 and F_2 the magnitude of force on wire 2. Then

A. $F_1 = \sqrt{3}F$

B. $F_2 = F$

C. Both (a) and (b) are correct

D. Both (a) and (b) are wrong

Answer: c

Watch Video Solution

31. A change q=1 C is at (3m,4m) and moving towards positive x-axis with constant velocity of 4 m/s. A long current carrying wire is at origin.

Current in this wire is 2.A and towards positive z-axis. Magnetic force on the charge at given instant is

A. $\left(1.64 \times 10^{7}\widehat{K}\right)N$

B. $-\left(1.92 \times 10^{-7}\widehat{K}\right)N$

C. $\left(4.8\widehat{J} - 3.2\widehat{K}\right) \times 10^{-7}N$

D. $\left(1.6\widehat{J} - 4.8\widehat{K}\right) \times 10^{-7}N$

Answer: b

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32. Two identical magnetic dipoles of magnetic moments $1 \cdot 0 Am^2$ each are placed at a separation of $2m$ with their axes perpendicular to each other. What is the resultant magnetic field at a point midway between the dipoles?

A. $5 \times 10^{-7} T$

B. $\sqrt{5} \times 10^{-7} T$

C. $10^{-7} T$

D. $2 \times 10^{-7} T$

Answer: b

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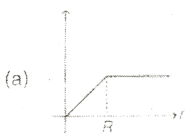
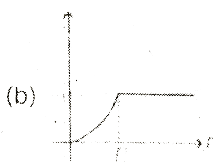
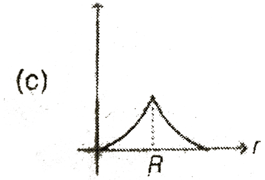
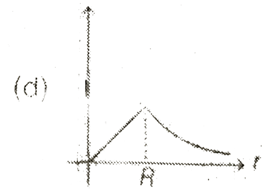
33. A cylinder wire of radius R is carrying uniformly distributed current I over its cross-section. If a circular loop of radius r is taken as amperian loop, then the variation value of $\oint \overrightarrow{B} \cdot \overrightarrow{dl}$ over this loop with radius 'r' of loop will be best represented by

A. 

B. 

C. 

D. 

Answer: b

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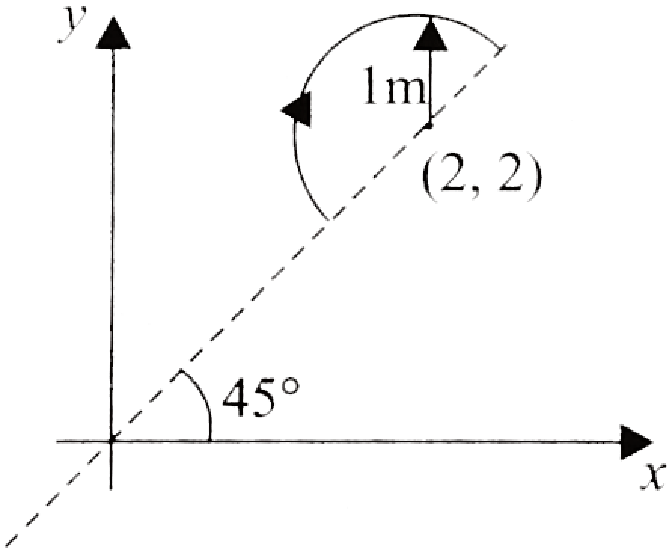
34. A uniform magnetic field $\overrightarrow{B} = 3\hat{i} + 4\hat{j} + \hat{k}$ exists in region of space. A semicircular wire of radius of 1 m carrying current 1 A having its centre at (2, 2, 0) is placed in x-y plane as shown in Fig. The force on semicircular wire will be



A. $\sqrt{2}\left(\hat{\imath}+\hat{\jmath}+\widehat{K}\right)$

B. $\sqrt{2}\left(\hat{\imath}-\hat{\jmath}+\widehat{K}\right)$

C. $\sqrt{2}\left(\hat{\imath}+\hat{\jmath}+\widehat{K}\right)$

D. $\sqrt{2}\left(-\hat{\imath}+\hat{\jmath}+\widehat{K}\right)$

Answer: b

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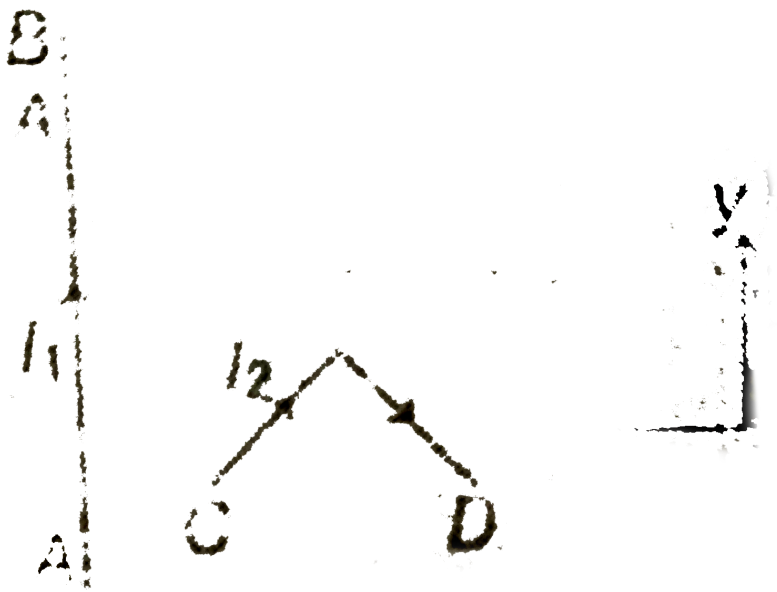
35. In the figure shown a current I_1 is established in the long straight wire AB. Another wire CD carrying currrent I_2 is placed in the plane of the paper. The line joining the ends of this wire is perpendicular to the wire AB. The resultant force on the wire CD is :



A. zero

B. towards negative x-axis

C. towards positive y-axis

D. None of the above

Answer: d

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36. An α is moving along a circle of radius R with a constant angular velocity ω. Point A lies in the same plane at a distance 2R from the centre. Point A records magnetic field produced by the α -particle. If the minimum time interval between two successive time at which A records zero magnetic field is t, the angular speed ω, in terms of t, is

A. $\frac{2\pi}{t}$

B. $\frac{2\pi}{3t}$

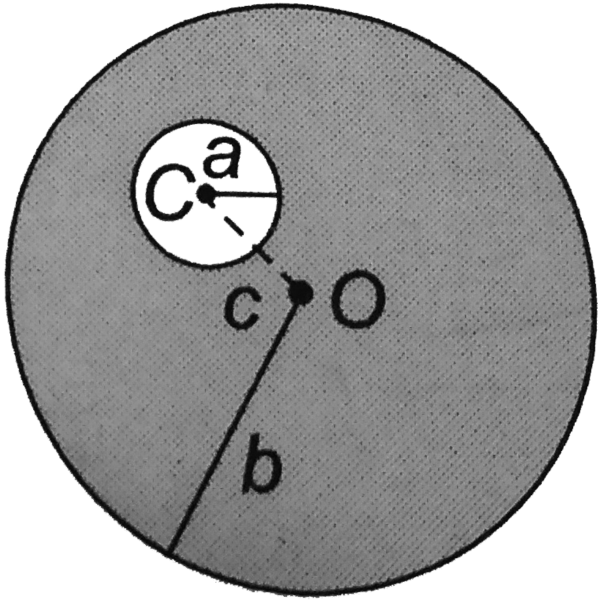
C. $\frac{\pi}{3t}$

D. $\frac{\pi}{2t}$

Answer: b

Watch Video Solution

37. 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 magnetic field on axis of hole. Given C is the centre of the hole and $OC = c$.



A. $\dfrac{\mu_0 i c}{\pi(b^2 - a^2)}$

B. $\dfrac{\mu_0 i c}{2\pi(b^2 - a^2)}$

C. $\dfrac{\mu_0 i (b^2 - a^2)}{2\pi c}$

D. $\frac{\mu_0 ic}{2\pi ab}$

Answer: b

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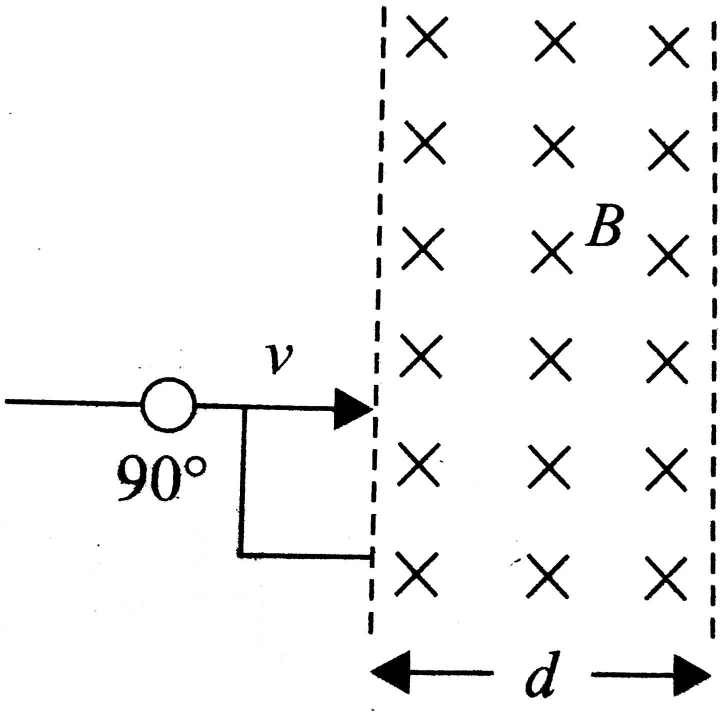
38. A positive charge particle of mass m and charge q is projected with velocity v as shown in Fig. If radius of curvature of charge particle in magnetic field region is greater than d, then find the time spent by the charge particle in magnetic field.



A. $\dfrac{m}{2qB}$

B. $\dfrac{2m}{qB}\sin^{-1}\left(\dfrac{d}{R}\right)$

C. $\dfrac{m}{qB}$

D. $\dfrac{m}{qB}\sin^{-1}\left(\dfrac{d}{R}\right)$

Answer: b

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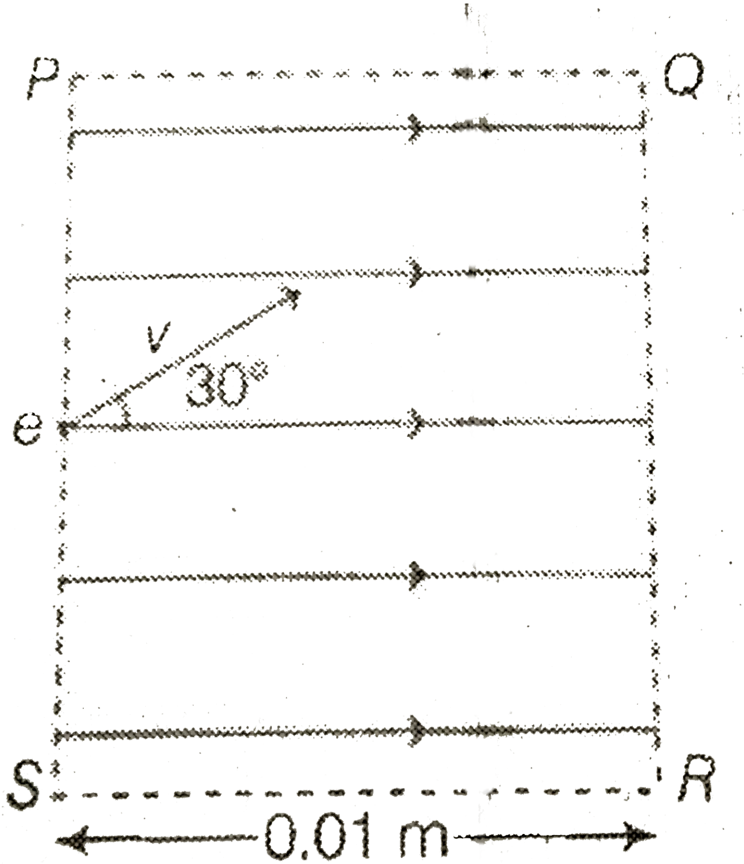
39. Refer to the figure. Rectangle PQRS represents the cross section of a uniform magnetic field region of 0.20 T. An electron is projected at a speed of $V = 2.0 \times 10^6 m/s$ into the region at an angle of 30° to the direction of the mangetic field. The length of the magnetic field region is 0.01 m. Find the number of revolutions made by the electron before it leaves the magnetic field region.



A. 28

B. 16

C. 9

D. 32

Answer: d

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40. In a certain region of space a uniform and constant electric field and a magnetic field parallel to each other are present. A proton is fired from a point A in the field with speed $V = 4 \times 10^4 m/s$ at an angle of α with the field direction. The proton reaches a point B in the field where its velocity makes an angle β with the field direction. If $\frac{\sin \alpha}{\sin \beta} = \sqrt{3}$. Find the electric potential difference between the points A and B. Take mp (mass of proton) $= 1.6 \times 10^{-27}$kg and e (magnitude of electronic charge) $= 1.6 \times 10^{-19}$C.

A. 16 V

B. 40 V

C. 90 V

D. 30 V

Answer: a

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41. A particle of specific charge $q/m = (\pi)C/kg$ is projected from the origin towards positive x-axis with a velocity of $10m/s$ in a uniform magnetic field $\overrightarrow{B} = -2\widehat{K}$ Tesla. The velocity $\overrightarrow{V}$ of the particle after time $t = 1/6$ s will be

A. $\left(5\hat{i} + 5\sqrt{3}\hat{j}\right)m/s$

B. $10\widehat{J}m/s$

C. $\left(5\sqrt{3}\hat{i} - 5\hat{j}\right)m/s$

D. $-10\hat{j}m/s$

Answer: a

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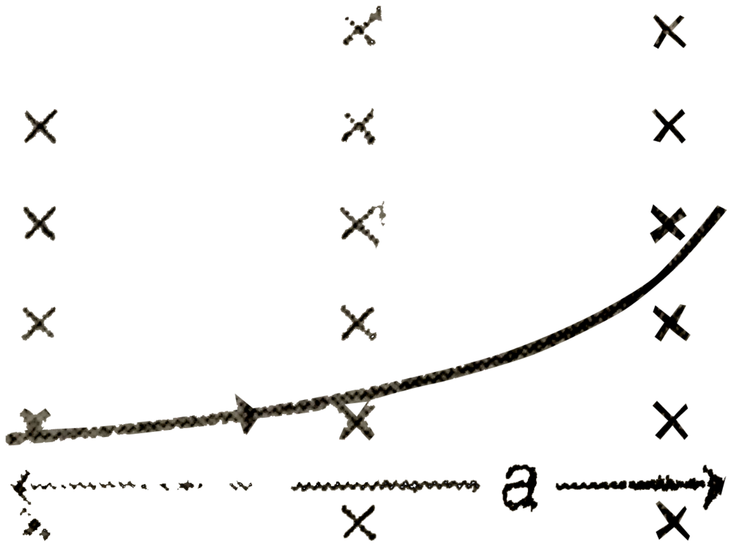
42. In a certain region of space there exists a constant and uniform magnetic field of induction B. The width of the magnetic field is a. A charged particle having charge q is projected perpendicular to B and along the width the field. If deflection produced by the fiel perpendicular to the width is d, then the magnitud of the momentum of the particle is,



A. $\frac{\left(d^2+a^2\right)}{2d}qB$

B. $\frac{a^2}{2d^2}qB$

C. $\frac{4d^2}{(a+d)}qB$

D. $\frac{\left(a^2-d^2\right)}{2d}qB$

Answer: a

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43. In a certain region of space, there exists a uniform and constant electric field of strength E along x-axis and uniform constant magnetic field of induction B along z-axis. A charge particle having charge q and mass m is projected with speed v parallel to x-axis from a point (a, b, 0). When the particle reaches a point(2a, $b/2$, 0) its speed becomes 2v. Find the value of electric field strength in term of m, v and co-ordinates.

A. $\frac{3}{2}\frac{mv^2}{qa}$

B. $\frac{mv^2}{qb}$

C. $\frac{2mv^2}{qa}$

D. $\frac{mv^2}{2qa}$

Answer: a

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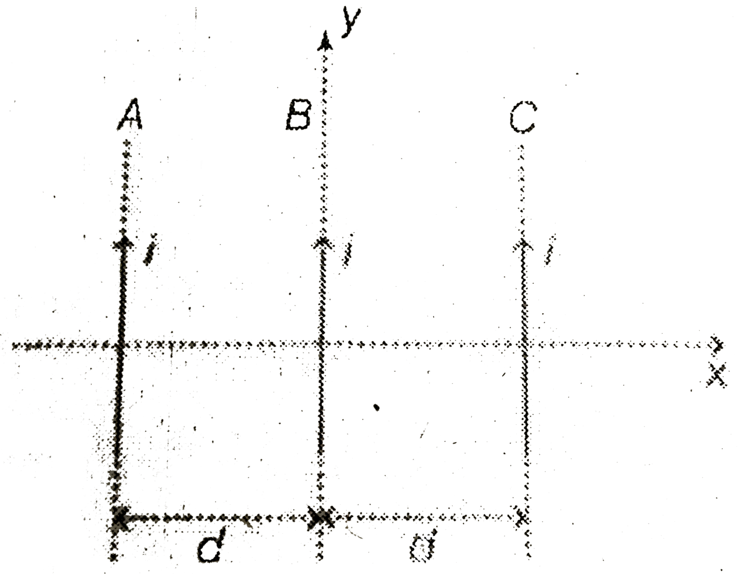
44. Three long wires are placed in xy plane in a gravity free space. 'I' is the current flowing in each wire. The currents are constant in magnitude. Distance between each wire is 'd' and λ is the mass per unit length of each wire. Wires 'A' and wire 'C' are fixed and wire 'B' is slightly displaced along 'z' axis. The period of oscillation of wire 'B' is



A. $\frac{\pi d}{i}\sqrt{\frac{\lambda \pi}{\mu_0}}$

B. $\frac{2\pi d}{i}\sqrt{\frac{\lambda \pi}{\mu_0}}$

C. $\frac{\pi d}{2i}\sqrt{\frac{\lambda \pi}{\mu_0}}$

D. $\frac{4\pi d}{i}\sqrt{\frac{\lambda \pi}{\mu_0}}$

Answer: b

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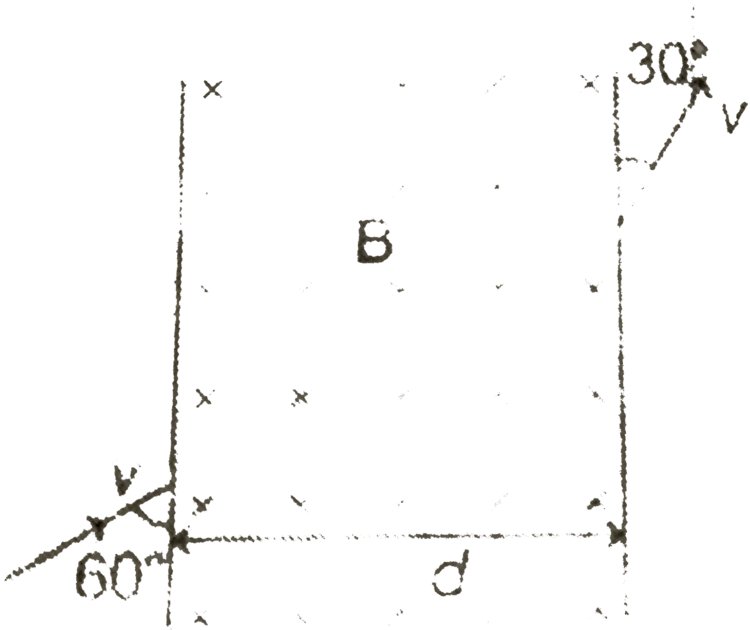
45. A charge particle of charge 'q' and mass 'm' enters in a given magnetic field 'B' and perpendicular to the magnetic field as shown in the figure. It enters at an angle of 60° with the boundary surface of magnetic field and comes out at an angle of 30° with the boundary surface of the magnetic field as shown in the figure. Find width 'd' in which magnetic field



exist.

A. $\frac{\left(\sqrt{3}-1\right)mv}{4qB}$

B. $\frac{\left(\sqrt{3}-1\right)mv}{qB}$

C. $\frac{\left(\sqrt{3}-1\right)mv}{3qB}$

D. $\frac{(\sqrt{3}-1)mv}{2qB}$

Answer: d

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More Than One Option Is Correct

1. A portion is fired from origin with velocity $\overrightarrow{v}=v_0\hat{j}+v_0\hat{k}$ in a uniform magnetic field $\overrightarrow{B}=B_0\hat{j}$. In the subsequent motion of the proton

A. its Z co-ordinate can never be negative

B. its x co-ordinate can never be positive

C. its x and z co-ordinates cannot be zero at the same time

D. its y co-ordinate will be proportional to its time of flight

Answer: b,d

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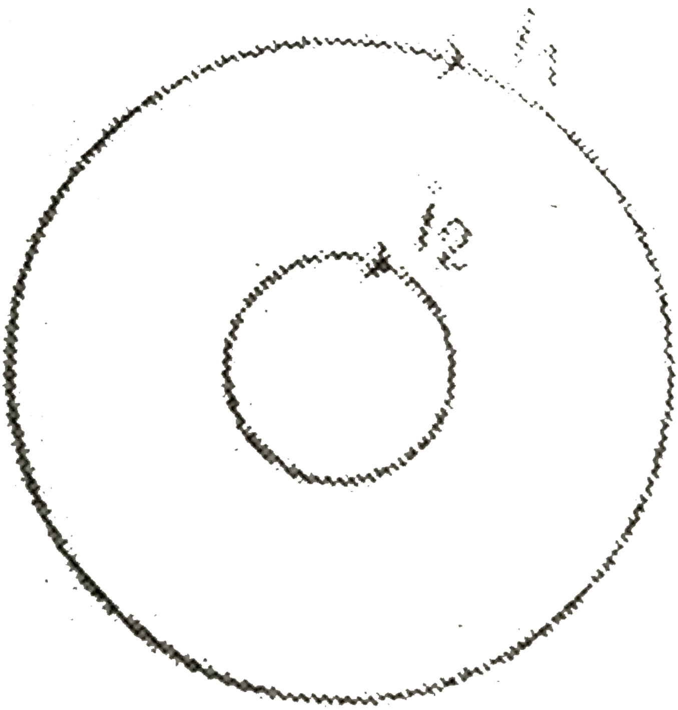
2. Two concentric circular coils of radii R and r $(< < R)$ carry currents of i_1 and i_2 respectively. If the smaller coil is rotated slightly about one of its diameter, it starts oscillating. Then, which of the following statement(s)

is / are correct ?



A. The oscillations are simple harmnic in nature

B. The frequency of oscillation is proportional to product $i_1 i_2$

C. The frequency of oscillation is proportional of square root of R

D. The frequency of osillation is independent of radius r

Answer: a,d

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3. A circular coil of n turns and radius r carries a current I. The magnetic field at the centre is

A. $\frac{\mu_0 i}{2R}$

B. $\frac{i}{2c^2 \varepsilon_0 R}$

C. $\frac{\mu_0 i}{2\pi R}$

D. $\frac{ic^2}{2\varepsilon_0 R}$

Answer: a,b

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4. A particle is projected in a plane perpendicular to a uniform magnetic field. The area bounded by the path described by the particle is proportional to

A. directly proportional to kinetic energy of particle

B. directly proportional to momentum of the particle

C. inversely proportional to magnetic field strength

D. inversely proportional to charge on particle

Answer: a,c,d

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5. In a region where both non-zero uniform electric field and magnetic field coexist, the path of a charged particle

A. can not be a circle

B. may be a circle

C. may be a straight line

D. may be a helix

Answer: a,c,d

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6. Which of the following statement(s) is/are correct ?

A. Units of magnetic field B can be written as

$$\frac{N}{A - m}$$

B. Units of magnetic permeability μ_0 can be wirtten as $\frac{N}{A^2}$

C. Units of magnetic flux ϕ can be written as

$$\frac{N}{A - m^2}$$

D. Units of magnetic flux can be $\frac{N - m^2}{A}$

Answer: a,b

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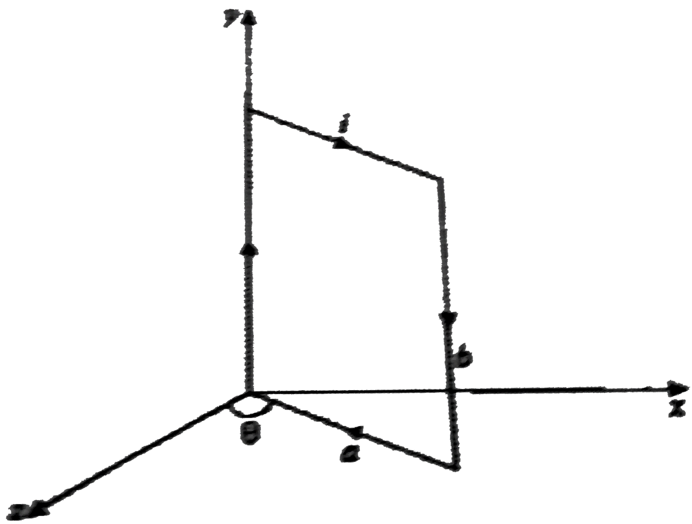
7. A rectangular loop of dimensions $(a \times b)$ carries a current i. A uniform magnetic field $\overrightarrow{B} = B_0 \hat{i}$ exists in space. Then :



A. torque on the loop is $iabB_0 \sin\theta$

B. torque on the loop is in negative y-direction

C. if allowed to move, the loop turn so as to increases θ

D. if allowed to move, the loop turn so as to decrease θ

Answer: a,b,d

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8. A charged particle with velocity $\hat{v} = x\hat{i} + y\hat{j}$ moves in a magnetic field $\overrightarrow{B} = y\hat{i} + x\hat{j}$. The force acting on the particle has magnitude F.

Which one of the following statements is are correct?

A. No force will act on particle, if x=y

B. $F \propto (x^2 - y^2)$ if x is greater than y

C. The force will act along z-axis, if x greater than y

D. The force will act along y-axis, if y greater than x

Answer: a,b,c

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9. Velocity and acceleration vector of a charged particle moving in a magnetic field at some instant are $\overrightarrow{v} = 3\hat{i} + 4\hat{j}$ and $\overrightarrow{a} = 2\hat{i} + x\hat{j}$. Select the correct options.

A. $x = -1.5$

B. $x = 3$

C. Magnetic field is along z-direction

D. Kinetic energy of the particle is constant

Answer: a,c,d

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10. A proton enters in a uniform electric and magnetic fields E and B respectively. Velocity of proton is v. All the three vectors are mutually perpendicular. The proton is deflected along positive x-axis when either of the fields or both are switched on simultaneously. Which of the following statement(s) is/are correct ?

A. V may be along positive y-axis

B. E is along positive x-axis

C. B may be along positive z-axis

D. B may be along negative y-axis

Answer: a,b,c

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11. 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. $a = bc$

Answer: a,d

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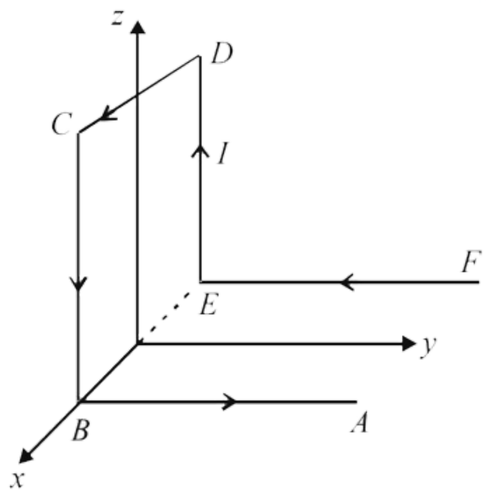
12. A wire $ABCDEF$ (with each side of length L) bent as shown in figure and carrying a current I is placed in a uniform magnetic induction B

parallel to the positive $y-direction$. The force experienced by the wire is .... In the .... direction .



A. the force experienced by the wire is I LB

B. the force experienced by the wire is 3i LB

C. the net force in the wire is in negative z-direction

D. the net force in the wire is in positive z-direction

Answer: a,d

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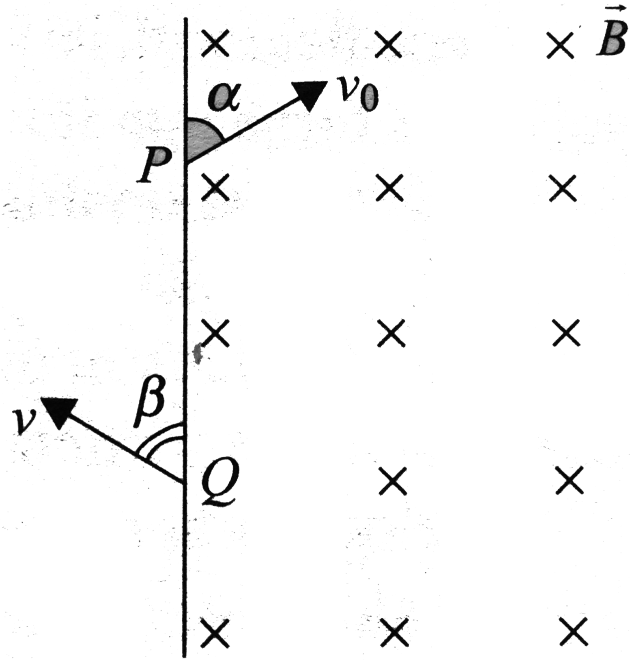
13. A particle of charge -q and mass m enters a uniform magnetic field $\overrightarrow{B}$ (perpendicular to paper inward) at P with a velocity v_0 at an angle α and leaves the field at Q with velocity v at angle β as shown in fig.



A. $\alpha = \beta$

B. $v = v_0$

C. $PQ = \dfrac{2mv_0 \sin\alpha}{Bq}$

D. particle remains in the field for time

$$t = \frac{2m(\pi - \alpha)}{Bq}$$

Answer: all

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14. A charged particle of specific charge α moves with a velocity $\overrightarrow{v} = v_0 \hat{i}$ in a magnetic field $\overrightarrow{B} = \frac{B_0}{\sqrt{2}}\left(\hat{j} + \hat{k}\right)$. Then (specific charge=charge per unit mass)

A. path of the particle is a heix

B. path of the particle is a circle

C. distance moved by the particle in time $t = \frac{\pi}{B_0\alpha}$ is $\frac{\pi}{B_0}$

D. velocity of particle after time $t = \frac{\pi}{B_0\alpha}$ is $\left(\frac{v_0}{2}\hat{i} + \frac{v_0}{2}\right)$

Answer: b,c

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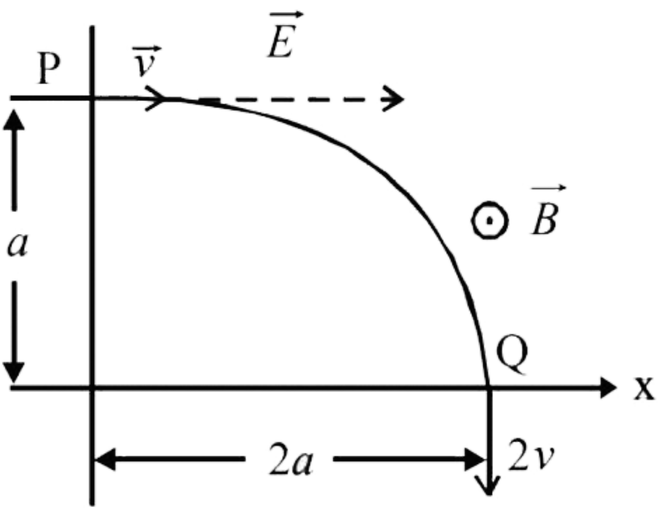
15. A particle of charge $+q$ and mass m moving under the influence of a uniform electric field $E\hat{i}$ and uniform magnetic field $B\hat{k}$ follows a trajectory from $P \rightarrow Q$ as shown in fig. The velocities at P and Q are $v\hat{i}$ and $-2v\hat{j}$. which of the following statement(s)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



A. $E = \dfrac{3}{4}\left(\dfrac{mv^2}{qa}\right)$

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 electric field at P is zero

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

Answer: a,b,d

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16. A charged particle of unit mass and unit charge moves with velocity $\overrightarrow{v} = \left(8\hat{i} + 6\hat{j}\right) ms^{-1}$ in magnetic field of $\overrightarrow{B} = 2\hat{k}T$. Choose the correct alternative (s).

A. (a) the path of the particle may be $x^2 + y^2 - 4x - 21 = 0$

B. (b) the path of the particle may be $x^2 + y^2 = 25$

C. (c) the path of the particle may be $y^2 + z^2 = 25$

D. (d) the time period of the particle will be

3.14 s

Answer: a,b,d

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17. A charged particle moves in a uniform magnetic field $B = \left(2\hat{i} - 3\hat{j}\right)$ T

A. (a) if velocity of the particles is $\left(6\widehat{K}\right)m/s$, particle moves in a circle

B. (b) if velocity of the particle is $\left(-4\hat{i}+6\hat{j}\right)m/s$, particle moves in a straight me

C. (c) if velocity of the particle is $\left(\hat{i}+2\hat{j}\right)m/s$, particle moves in a helical path

D. (d) In all the above three cases speed of the particle remains unchanged

Answer: all

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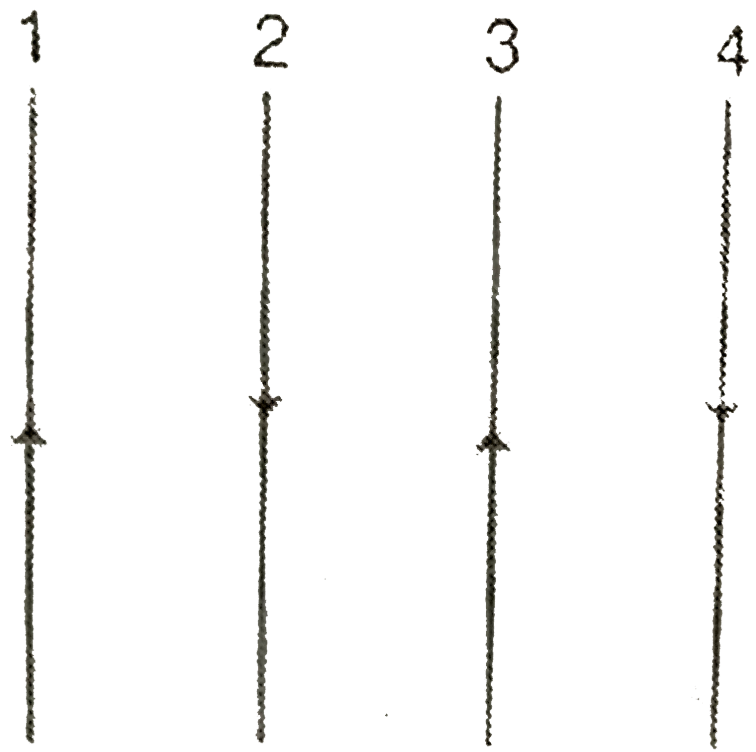
18. Four infinitely long wires carring equal currents are placed parallel and equidistant as shown in figure. Then magnitude of force



A. on 1 and 4 are equal

B. on 2 and 3 are equal

C. on 2 is maximum

D. on 4 is minimum

Answer: a,b

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19. Velocity of a charged particle can remain unchanged. If

A. it is moving only in electric field

B. it is moving only in magnetic field

C. it is moving both in electric and magnetic fields

D. neither in electric nor in magnetic fields

Answer: b,c,d

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20. Two identical coils are placed coaxially. They carry equal currents in same direction

NOTE in parts (a), (b) and (c) exclude the points at infinity.

A. (a)on their axis there are two points where net magnetic field is zero

B. (b)on their axis there are three points where net magnetic field is zero

C. (c)on their axis there is no such point where net magnetic field is zero

D. (d)on moving from the centre of one coil to the other, magnetic field will first decrease then increase

Answer: c

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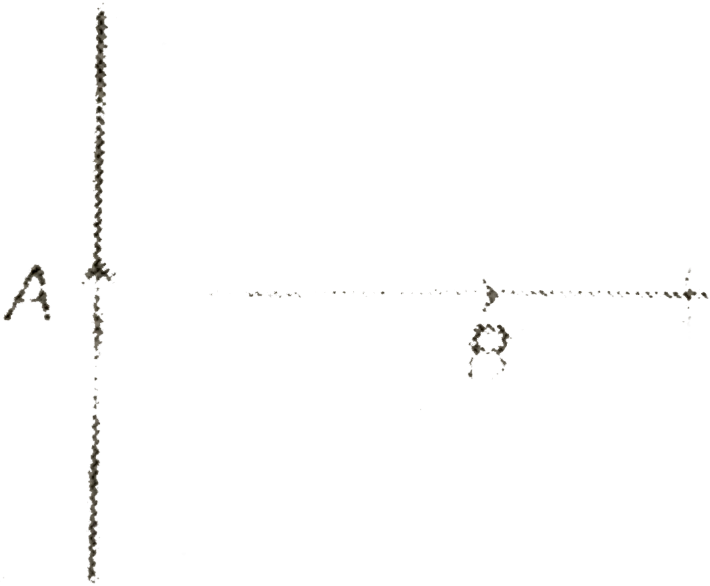
21. A wire B of finite length is kept on the right hand side of a long wire A as shown. Direction of currents on both the wires are shown in figure. Suppose F is the force on wire B and τ the torque on it. Then



A. F is upward

B. F is downward

C. τ is clockwise

D. τ is anticlockwise

Answer: a,c

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22. An α-particle and a proton having same kineti energy enetrs in uniform magnetic field perpendicularly. Let x be the ratio of their magnitude of accelation any y the ratio of their time periods. Then

A. $x = \frac{1}{(2)^{3/2}}$

B. $x = \frac{1}{4}$

C. $y = 2$

D. $y = 4$

Answer: b,c

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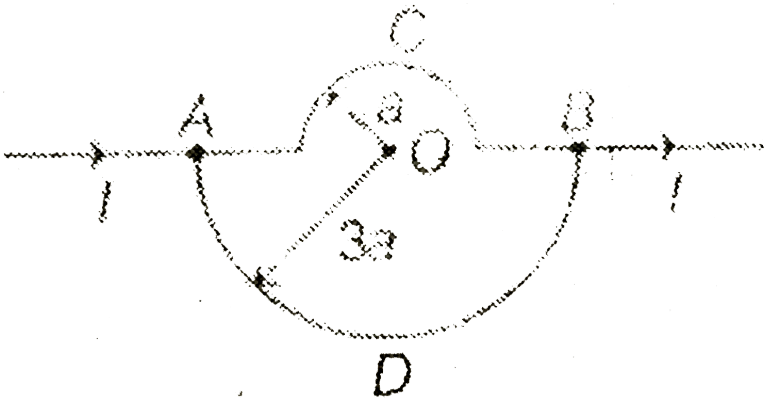
23. In the given diagram, there are two semicircular parts one having radius 'a' and another having radius '3a' as shown. If resistance of ACB part is R and resistance of ADB part is 3R.

Select the correct option(s):



A. Current through ACB is $I/4$

B. Current through ADB is $I/4$

C. Magnitude of magnteic field at O due to ACB part is $\frac{3\mu_0 I}{16a}$

D. Magnitude of magnetic field at O due to ADB part is $\frac{\mu_0 I}{48a}$

Answer: b,c,d

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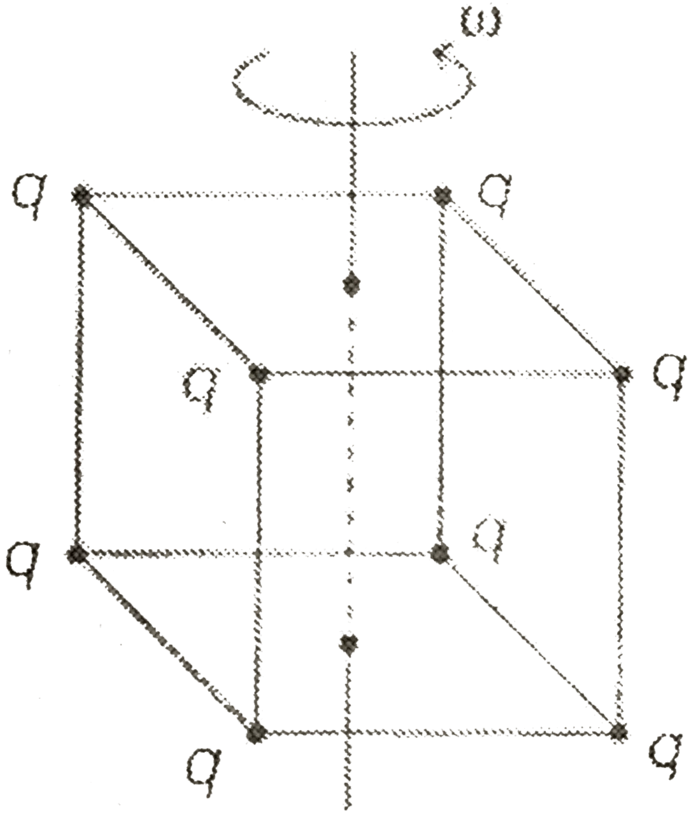
24. Choose the correct option:

Consider a cube of side 'a' as shown. Eight point charges are placed at the corners. The cube is rotated about the central axis with constant angular velocity ω :



A. (a) Net magnetic field at the centre of cube

is zero

B. (b) Net magnetic field at the centre of cube is $\sqrt{\frac{2\mu_0 q\omega}{\pi a}}$

C. (c) Net magnetic field at the centre of cube is $\frac{8}{3\sqrt{3}}\frac{\mu_0 q\omega}{\pi a}$

D. (d) if polarity of any four charges are reversed, then magnetic field at the centre of cube will be zero

Answer: c,d

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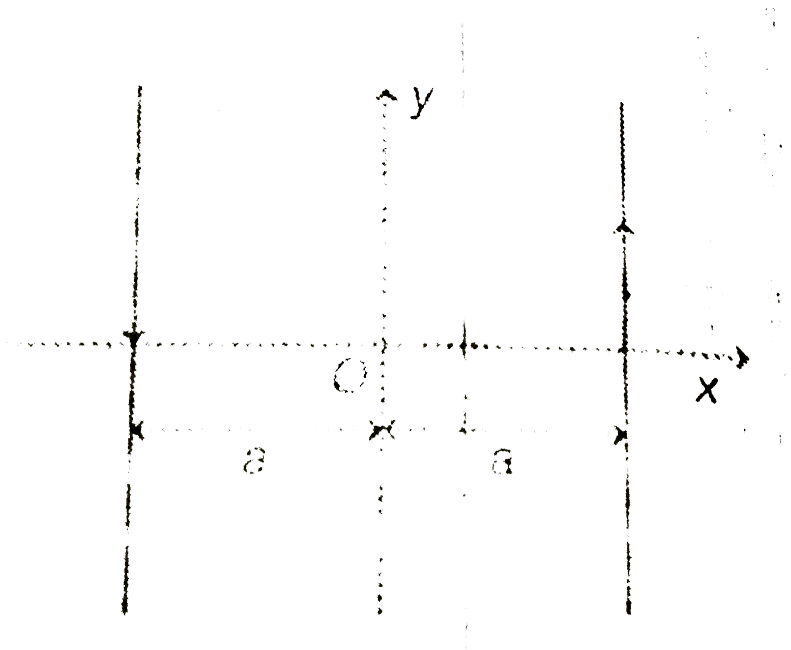
25. Two infinitely long straight current carrying wires are placed parallel to y-axis in xy plane. Each wire carries current I in opposite directions as shown. A charged particle of charge $+q$ and mass m is project from position P(0,0,0a) with initial velocity v=i. Then



A. The magnitude of initial acceleration of the particle $\dfrac{\mu_0 lqv}{2\pi am}$

B. The direction of initial acceleration of the particle is parallel to positve x-axis

C. The direction of initial acceleration of the particle is parallel to positive y-axis

D. The radius of curvature of the path of the particle just after it is projected is $\dfrac{2\pi mav}{\mu_0 lq}$

Answer: a,c,d

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Comprehension Type Questions

1. Magnetic force on a charged particle is given by $\overrightarrow{F}_m = q\left(\overrightarrow{v} \times \overrightarrow{B}\right)$ and electrostatic force $\overrightarrow{F}_e = q\overrightarrow{E}$. A particle having charge q = 1C and mass 1 kg is released from rest at origin. There are electric and magnetic field given by $\overrightarrow{E} = \left(10\hat{i}\right)N/Cf$ or $x = 1.8m$ and $\overrightarrow{B} = -\left(5\hat{k}\right)T$ for $1.8m \le x \le 2.4m$

A screen is placed parallel to y-z plane at

$x = 3m$. Neglect gravity forces.

The speed with which the particle will collide the screen is

A. 3

B. 6

C. 9

D. 12

Answer: b

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2. Magnetic force on a charged particle is given by $\overrightarrow{F}_m = q\left(\overrightarrow{v} \times \overrightarrow{B}\right)$ and electrostatic force $\overrightarrow{F}_e = q\overrightarrow{E}$. A particle having charge q = 1C and mass 1 kg is released from rest at origin. There are electric and magnetic field given by

$\overrightarrow{E} = \left(10\hat{i}\right)N/Cf \text{ or } x = 1.8m$ and

$\overrightarrow{B} = -\left(5\hat{k}\right)T$ for $1.8m \leq x \leq 2.4m$

A screen is placed parallel to y-z plane at $x = 3m$. Neglect gravity forces.

y-coordinate of particle where it collides with screen (in meters) is

A. $\frac{0.6(\sqrt{3}-1)}{\sqrt{3}}$

B. $\frac{0.6(\sqrt{3}+1)}{\sqrt{3}}$

C. $1.2(\sqrt{3}+1)$

D. $\frac{1.2(\sqrt{3}-1)}{\sqrt{3}}$

Answer: d

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3. Magnetic force on a charged particle is given by $\overrightarrow{F}_m = q\left(\overrightarrow{v} \times \overrightarrow{B}\right)$ and electrostatic force

$\overrightarrow{F}_e = q\overrightarrow{E}$. A particle having charge q = 1C and mass 1 kg is released from rest at origin. There are electric and magnetic field given by $\overrightarrow{E} = \left(10\hat{i}\right) N/C f$ or $x = 1.8m$ and $\overrightarrow{B} = -\left(5\hat{k}\right) T$ for $1.8m \leq x \leq 2.4m$

A screen is placed parallel to y-z plane at $x = 3m$. Neglect gravity forces.

The speed with which the particle will collide the screen is

A. $\frac{1}{5}\left(3 + \frac{\pi}{6} + \frac{1}{\sqrt{3}}\right)$

B. $\frac{1}{5}\left(6 + \frac{\pi}{3} + \sqrt{3}\right)$

C. $\frac{1}{3}\left(5+\frac{\pi}{6}+\frac{1}{\sqrt{3}}\right)$

D. $\frac{1}{3}\left(6+\frac{\pi}{18}+\sqrt{3}\right)$

Answer: a

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4. A charged particle (q.m) released from origin with velocity $v = v_0\hat{i}$ in a uniform magnetic field $B = \frac{B_0}{2}\hat{i} + \frac{\sqrt{3}B_0}{2}\hat{J}$.

Pitch of the helical path described by the particle is

A. $\frac{2\pi m v_0}{B_0 q}$

B. $\frac{\sqrt{3}\pi m v_0}{2B_0 q}$

C. $\frac{\pi m v_0}{B_0 q}$

D. $\frac{2\sqrt{3}\pi m v_0}{B_0 q}$

Answer: c

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5. A charged particle (q.m) released from origin with velocity $v = v_0 \hat{i}$ in a uniform magnetic field

$$B = \frac{B_0}{2}\hat{i} + \frac{\sqrt{3}B_0}{2}\hat{J}.$$

Z-component of velocity is $\frac{\sqrt{3}v_0}{2}$ after in t=.........

A. $\frac{2\pi m}{B_0 q}$

B. $\frac{\pi m}{B_0 q}$

C. $\frac{\pi m}{2B_0 q}$

D. $\frac{2\pi m}{4B_0 q}$

Answer: c

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6. A charged particle (q.m) released from origin with velocity $v = v_0\hat{i}$ in a uniform magnetic field $B = \frac{B_0}{2}\hat{i} + \frac{\sqrt{3}B_0}{2}\hat{J}$.

Maximum z-coordinate of the particle is

A. $\frac{\sqrt{3}mv_0}{B_0q}$

B. $\frac{2\sqrt{3}mv_0}{B_0q}$

C. $\frac{2mv_0}{B_0q}$

D. $\frac{mv_0}{B_0q}$

Answer: a

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7. A charged particle (q.m) released from origin with velocity $v = v_0 \hat{i}$ in a uniform magnetic field $B = \frac{B_0}{2}\hat{i} + \frac{\sqrt{3}B_0}{2}\hat{J}$.

Maximum z-coordinate of the particle is

A. (a)$v_x = 0$

B. (b)$v_y = v_0$

C. (c)Both (a) and (b) are correct

D. (d)Both (a) and (b) are wrong

Answer: d

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8. A current carrying ring with its center at origin and moment of inertia $2 \times 10^{-2} kg - m^2$ about an axis passing through its centre and perpendicular to its plane has magnetic moment $M = \left(3\hat{i} - 4\hat{j}\right) \quad A - m^2$. At time t=0 a magnetic field $B = \left(4\hat{i} + 3\hat{j}\right)$ T is switched on. Angular acceleration of the ring at time t=0, in rad / s^2 is

A. 5000

B. 1250

C. 2500

D. zero

Answer: c

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9. A current carrying ring with its center at origin and moment of inertia $10^{-2} kg - m^2$ about an axis passing through its centre and perpendicular to its plane has magnetic moment $M = \left(3\hat{i} - 4\hat{j}\right) \quad A - m^2$. At time t=0 a magnetic field $B = \left(4\hat{i} + 3\hat{j}\right)$ T is switched on. Maximum angular velocity of the ring in rad/s will be

A. $50\sqrt{2}$

B. $25\sqrt{2}$

C. $100\sqrt{2}$

D. $150\sqrt{2}$

Answer: a

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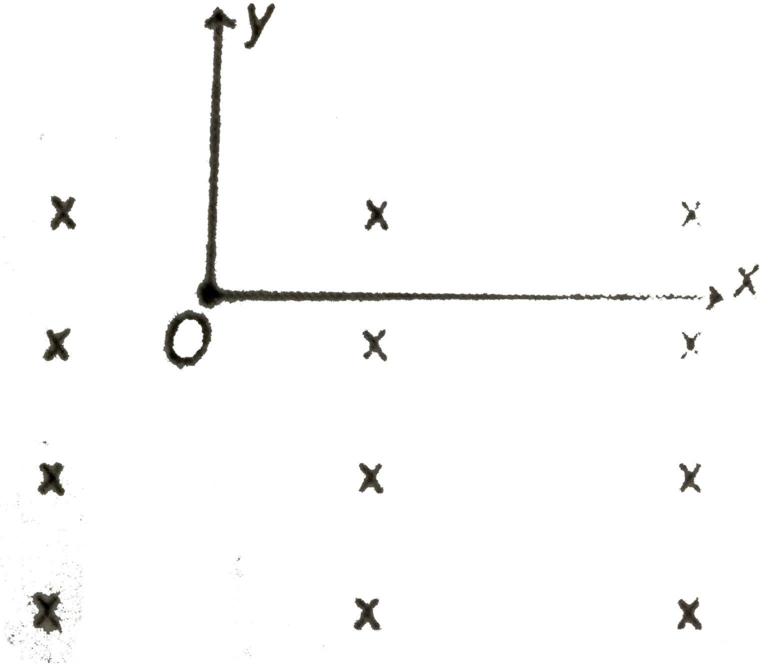
10. A particle is released from rest from origin O. There is a uniform magnetic field in negative z-direction. Positive y-direction is vertically upwards. After falling through 5m the velocity vector makes an angle 30° with x-axis.



The path of the particle is

A. circular

B. helical with increasing pitch

C. straight line

D. None of the above

Answer: a

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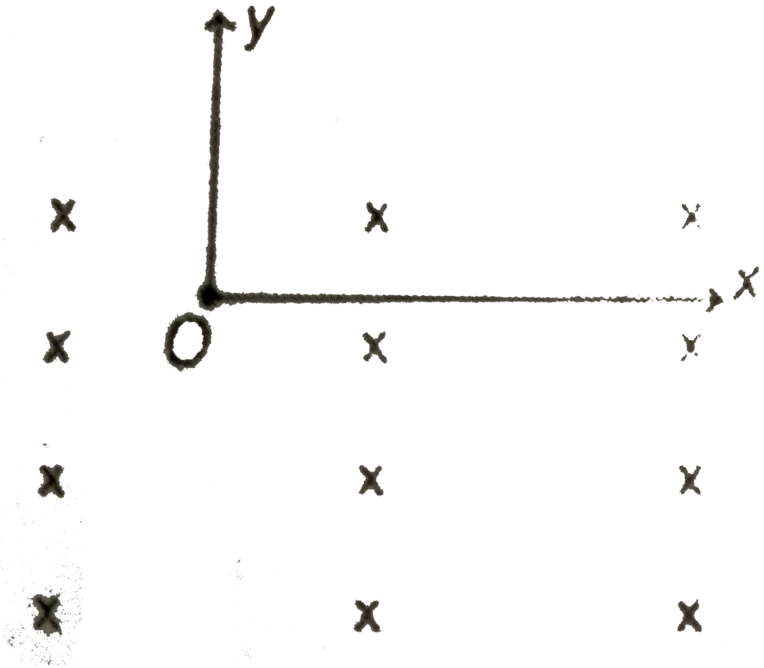
11. A particle is released from rest from origin O. There is a uniform magnetic field in negative z-direction. Positive y-direction is vertically upwards. After falling through 5m the velocity vector makes an angle 30° with x-axis.



Find the correct option

A. (a)x-component of velocity at the given instant as magnitude $5\sqrt{3}m/s$

B. (b)y-component of velocity at the given instant has magnitude $5m/s$

C. (c)Both (a) and (b) are correct

D. (d)Both (a) and (b) are wrong

Answer: c

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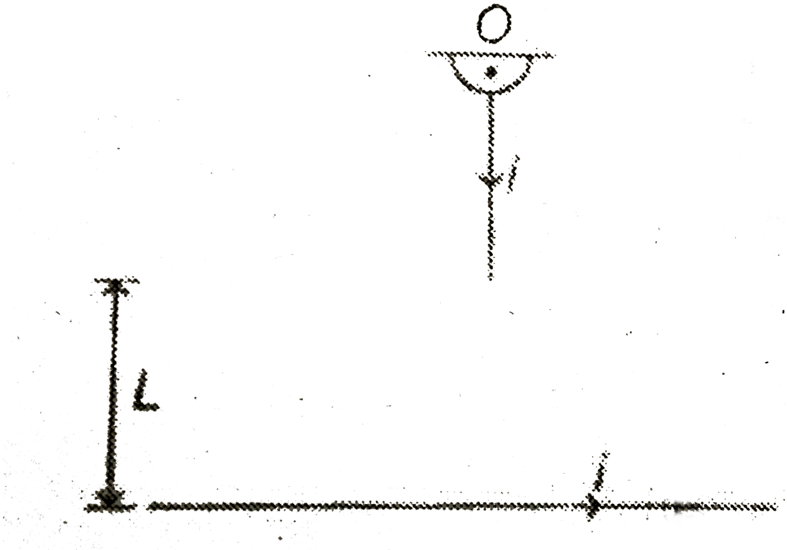
12. A wire of length L, mass m and carrying a current I is suspended from point O as shown, An another infinitely long wire carrying the same current I is at a distance L below the lower end of the wire. Given i=2A, L=1m and m=0.1kg (In

2=0.693)



What is the angular acceleration of the wire just after it is released from the position shown ?

A. $6.2 \times 10^{-8} \frac{rad}{s^2}$

B. $2.1 \times 10^{-4} \frac{rad}{s^2}$

C. $4.5 \times 10^{-5} \frac{rad}{s^2}$

D. $9.3 \times 10^{-6} \frac{rad}{s^2}$

Answer: d

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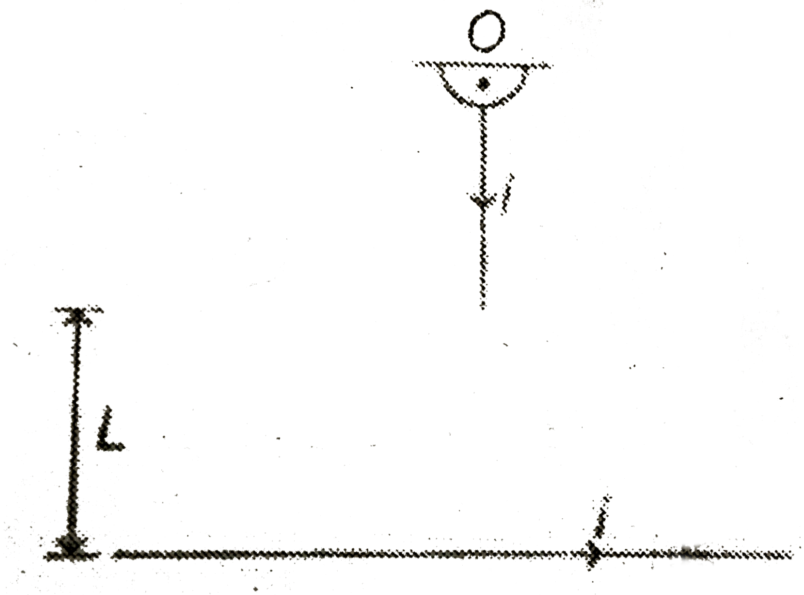
13. A wire of length L, mass m and carrying a current I is suspended from point O as shown, An another infinitely long wire carrying the same current I is at a distance L below the lower end of the wire. Given i=2A, L=1m and m=0.1kg (In 2=0.693)



What want to keep the suspended wire stationary by palcing a third inifinitely long wire carrying an upward current. Then this wire should be placed

A. to the left of suspended wire

B. to the right of suspended wire

C. we can't keep suspended wire stationary by placing a third wire to the right or to the left of it

D. we can keep it either to the right or to the left. It will depend on the magnitude of the current in the third wire

Answer: a

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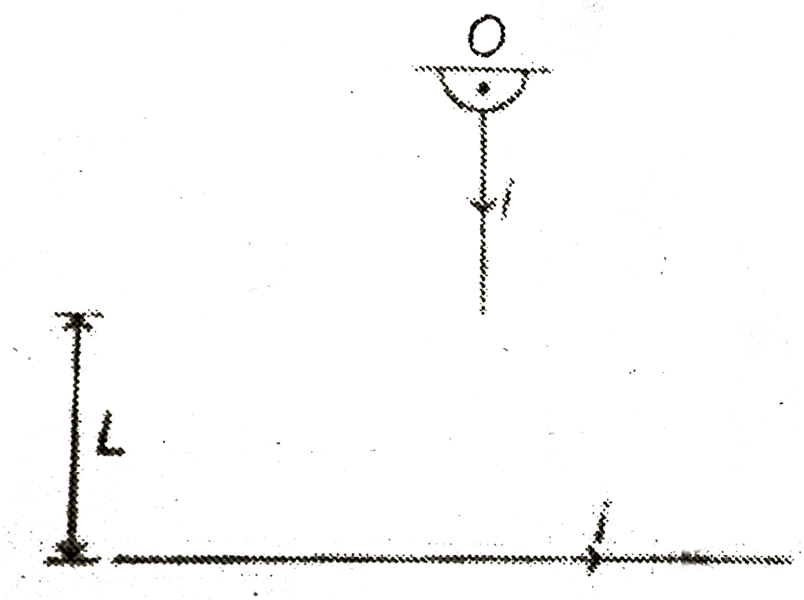
14. A wire of length L, mass m and carrying a current I is suspended from point O as shown, An another infinitely long wire carrying the same current I is at a distance L below the lower end of the wire. Given i=2A, L=1m and m=0.1kg (In 2=0.693)



What want to keep the suspended wire stationary by palcing a third inifinitely long wire carrying an upward current. Then this wire should be placed

A. 2.9m

B. 1.9m

C. 1.3m

D. 2.4m

Answer: c

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15. A 100 turn closely wound circular coil of radius $10cm$ carries a current of $3 \cdot 2A$.What is the field at the centre of the coil?

A. $2 \times 10T$

B. 2×10^{-3}T

C. 2×10^{-6} T

D. 2×10^{-9}T

Answer: b

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16. A 100 turn closely wound circular coil of radius $10cm$ carries a current of $3 \cdot 2A$. (i) What is the field at the centre of the coil? (ii) What is the magnetic moment of this arrangement?

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Matrix Matching Type Questions

1. For the path of a charged particle math the following.

Table-1	Table-2
(A) in uniform electric field	(P) Straight line
(B) in uniform magnetic field	(Q) Parabola
(C) in uniform electric and magnetic field	(R) Circle
	(S) Helix

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2. In magnetic field $B = \left(2\hat{i} + 3\hat{j}\right)$ T, velocity of a charged particle is given in table-1. Corresponding magnetic force is given in table-2.

Match the two tables.

Table-1	Table-2
(A) $(4\hat{i} - 3\hat{j})$ m/s	(P) zero
(B) $(4\hat{i} - 6\hat{j})$ m/s	(Q) maximum
(C) $(6\hat{k})$ m/s	(R) may be along positive z-direction
	(S) must be along positive z-direction

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3. In magnetic field, for a charged particle (in motion) match the following table

Table-1	Table-2
(A) acceleration	(P) may be zero
(B) velocity	(Q) is zero
(C) speed	(R) may be constant
(D) kinetic energy	(S) is constant

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4. A charged particle is moving in a circular path in uniform magnetic field. Match the following.

Table-1	Table-2
(A) Equivalent current due to motion of charged particle	(P) is proportional to v
(B) Magnetic moment	(Q) is proportional to v^2
(C) Magnetic field at centre of circle due to motion of charged particle	(R) is proportional to v^0
	(S) None

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5. A circular current carrying loop is placed in x-y plane as shown in figure. A uniform magnetic field $B = B_0\widehat{K}$ is present in the region. Match the following.

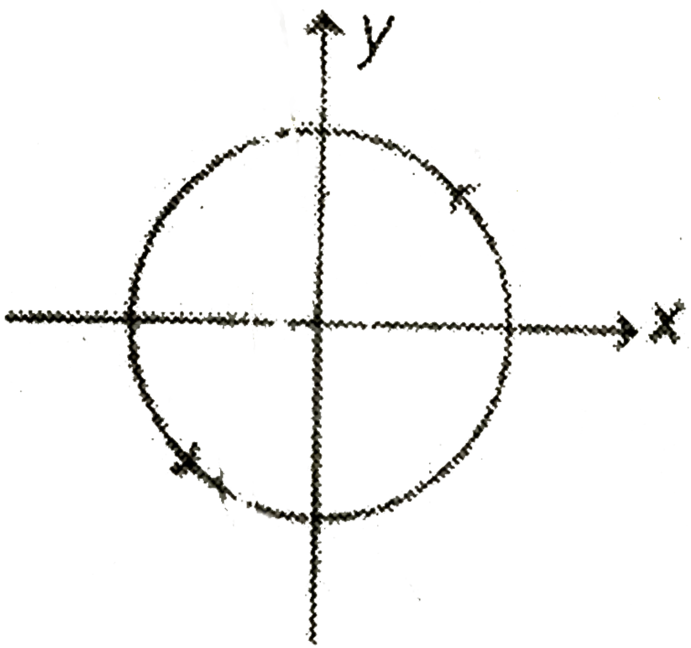

Table-1	Table-2
(A) Magnetic moment of the loop	(P) zero
(B) Torque on the loop	(Q) maximum
(C) Potential energy of the loop	(R) along positive z-axis
(D) Equilibrium of the loop	(S) stable
	(T) None

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6. An inifinitely long wire bent at 90° at point O shown in figure. Match the following.

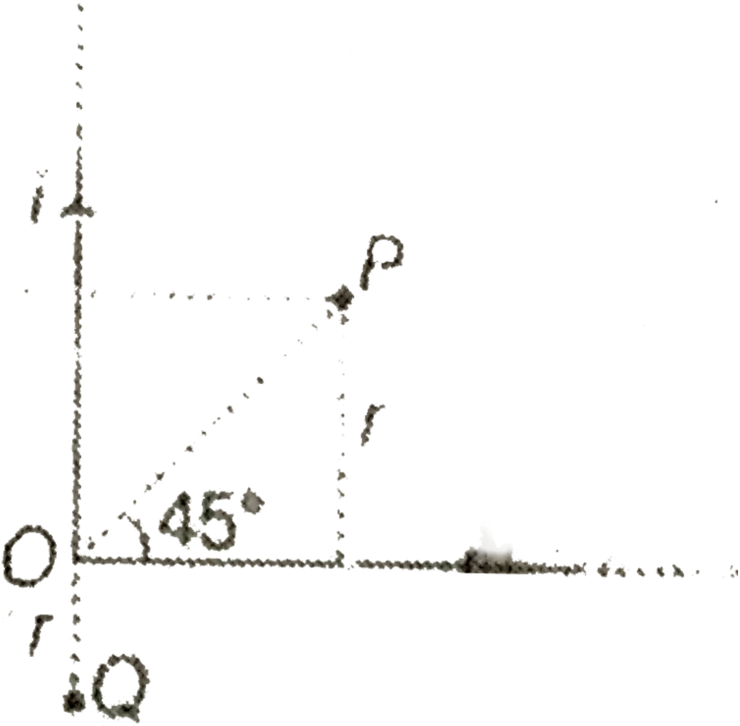

Table-1	Table-2
(A) Magnetic field at P	(P) inwards
(B) Magnetic field at Q	(Q) outwards
	(R) $\frac{\mu_0}{2\pi}\frac{i}{r}$
	(S) $\frac{\mu_0}{4\pi}\frac{i}{r}$

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7. Match the following.

Table-1	Table-2
(A) Magnetic field	(P) $[AL^2]$
(B) Magnetic moment	(Q) $[ATM^{-1}]$
(C) Ratio of magnetic moment to angular momentum	(R) $[MA^{-1}T^{-2}]$
(D) $\sqrt{\varepsilon_0 \mu_0}$	(S) $[L^{-1}T]$

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8. Equal currents I flow in two wires along x and y ax as shown. Match the following.

Table-1	Table-2
(A) Magnetic field in first quadrant	(P) inwards
(B) Magnetic field in second quadrant	(Q) outwards
(C) Magnetic field in third quadrant	(R) may be inwards or outwards
(D) Magnetic field in fourth quadrant	

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9. A current carrying wire is as shown in figure. An electron from point P moves with velocity v. Direction of v is given in table-1 and its deflection in table-2. Match the following.

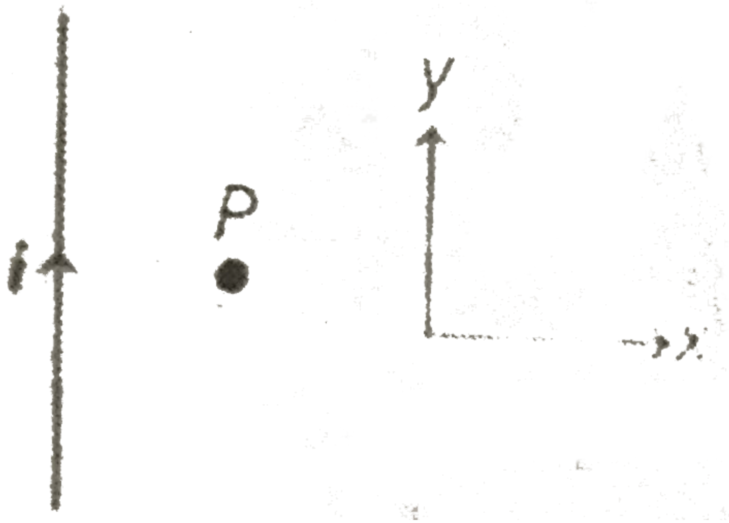

Table-1	Table-2
(A) positive *x*	(P) positive *y*
(B) positive *y*	(Q) negative *y*
(C) positive *z*	(R) positive *x*
	(S) undeflected
	(T) None

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10. There are four situations given in Table-1 involving a magnetic dipole of dipole moment M placed in uniform external magnetic field B. Table-2 gives corresponding results. Match the situations in Table-1 with the corresponding results in Table-2.

Table-1	Table-2
(A) Magnetic dipole moment M is parallel to uniform external magnetic field B (angle between both vectors is zero).	(P) force on dipole is zero
(B) Magnetic dipole moment M, is perpendicular to uniform external magnetic field M	(Q) torque on dipole is zero
(C) Angle between magnetic dipole moment M and uniform external magnetic field B is acute	(R) magnitude of torque is (MB)
(D) Angle between magnetic dipole moment M and uniform external magnetic field B is 180°.	(S) potential energy of dipole due to external magnetic field is (MB)

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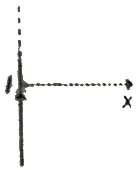
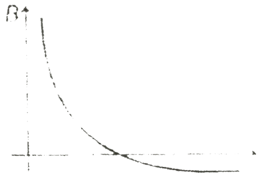
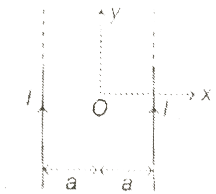
11. Some current carrying wires are given in Table-1 and graph of variation of magnetic field versus position of point P are given in Table-2.

Match the graph given in Table-2 for the current carrying wire in Table-2.

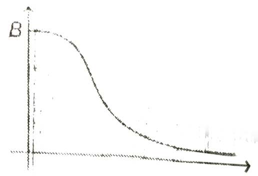
Table-1	Table-2
(A)  A long straight current carrying wire, placed along y-axis. Its magnetic field at point $P(x, 0, 0)$.	(P) 

(B)

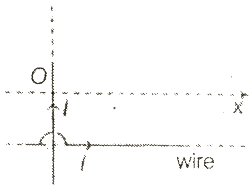


Two long parallel wires placed on xy plane. O is origin. Its magnetic field is observed at point $P(0, 0, z)$.

(Q)

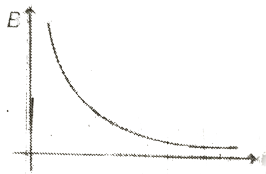


(C)

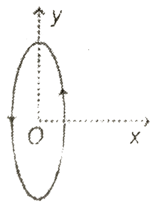


Two long parallel wires are placed one along y-axis and the other parallel to x-axis. Its magnetic field is observed at point $P(x, 0, 0)$.

(R)

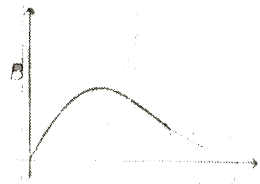


(D)



A current carrying ring is placed on y-z plane. Origin is at the centre of ring. It magnetic field is observed at point $P(x, 0, 0)$.

(S)



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12. Magnetic field exists in a space and given as $B = -\frac{B_0}{a} y\widehat{K}$, where B_0 and a are constants. A wire PQ, having current I lies inside the magnetic field. If co-ordinates of P and Q are as given, then find the force acting on the wire as given in Table-2. Match the two Table.

Table-1		Table-2
(A) (a, a, 0) and (2a, a, 0)	(P)	$3(B_0 a)I$
(B) (a, a, 0) and (a, 2a, 0)	(Q)	$\frac{3}{\sqrt{2}} B_0 a I$
(C) (a, a, 0) and (2a, 2a, 0)	(R)	$\frac{3}{2} B_0 a I$
(D) (a, a, a) and (2a, 2a, 2a)	(S)	$B_0 a I$

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Integer Type Questions

1. Two parallel, long wires carry currents $i_1 \text{and} i_2$ with $i_1 > i_2$. When the currents are in the same direction, the magnetic field at a point midway between the wires is 10 μT. If the direction of i_2 is reversed, the field becomes 30 μT. Find the ratio $\frac{i_1}{i_2}$.

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2. A charged particle enters into a uniform magnetic field with velocity v_0 perpendicular to it, the length of magnetic field is $x = \left(\sqrt{3}/2\right)$ R, where R is the radius of the circular path of the particle in the field. The magnitude fo change in velocity of the particle when it comes out of the field is

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3. A uniformly charged disc of radius r and having charge q rotates with constant angular velocity ω. The magnetic dipole moment of this disc is $\frac{1}{n}q\omega r^2$. Find the value of n.

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4. An electron is shot into one end of a solenoid.As it enters the uniform magnetic field within the solenoid, its speed is $800m/s$ and its velocity vector makes an angle of 30° with the central axis of the solenoid. The solenoid carries $4.0A$ current and has 8000 turn along its length.Find number of revolutions made by the electron within the solenoid by the time it emerges from the solenoid's opposite end. (Use charge of mass ratio $\frac{e}{m}$ for electron $= \sqrt{3} \times 10^{11} C / kg$)Fill your answer in multiple of 10^3 (neglect end effect)

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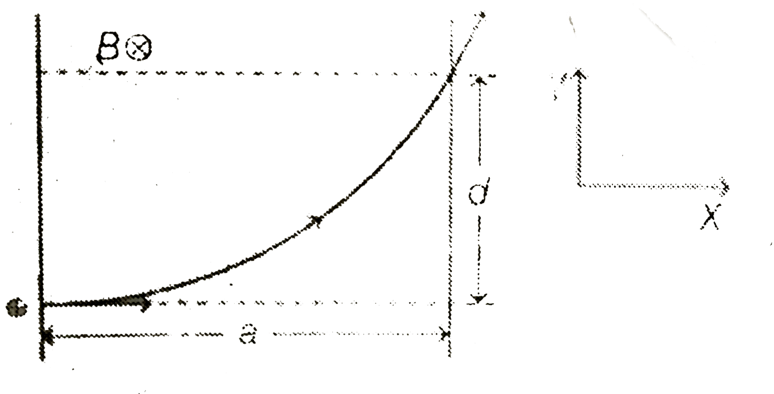
5. A particle of charge+q eneters a region of uniform magnetic field B (directed into the plane of paper) as shown in the figure. Particle is deflected by a distance d along y-axis after travelling a distance of a along x axis. Find magnitude of linear momentum of particle in Newton-sec. (Given: a=3m, d=4m, Bq=0.32c-Tesla)



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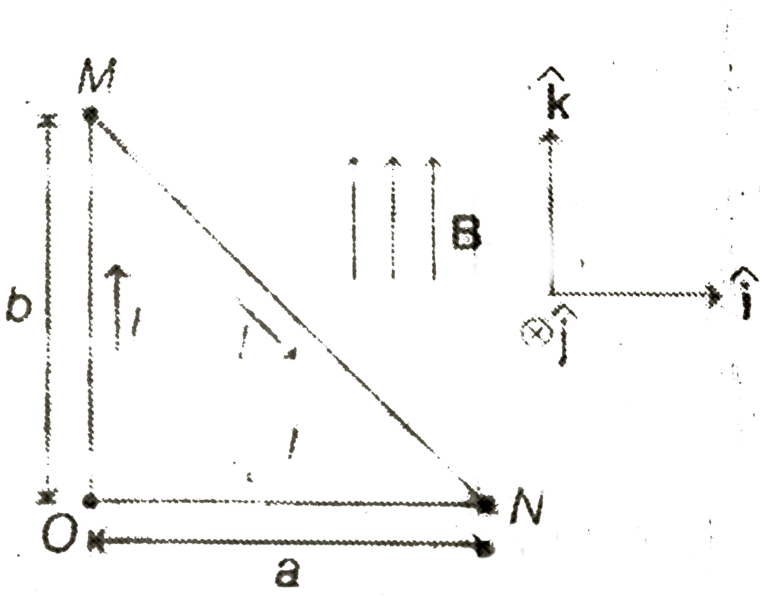
6. consider a triangular loop of wire with sides a and b. The loop carries a current I in the direction shown and is placed in a uniform magnetic field that has magnitude B and points in the same direction as the current in side OM of the loop. At the moment shown in the figure the torque on the current loop is τ. Find the value of $IabB / \tau$



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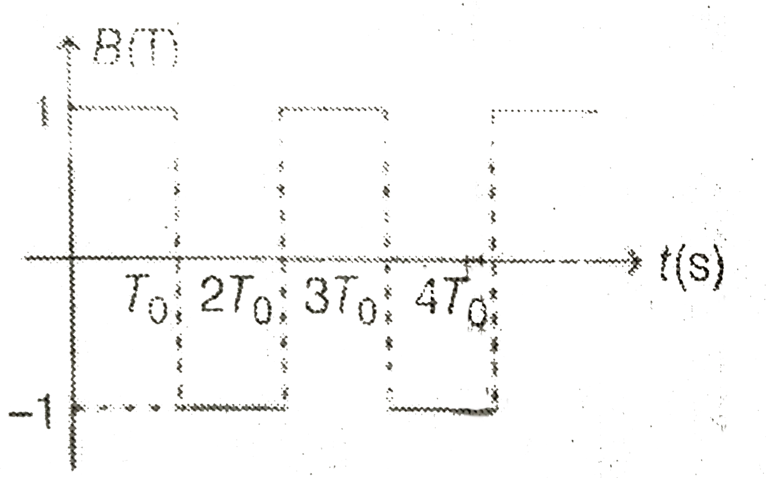
7. In a region, magnetic field along X-axis changes with time according to the given garph. A charged particle of mass 1 kg and charge 1C

located at origin starts moving with initial velocity $\left(\frac{2}{\pi}\hat{i}+2\sqrt{3}\hat{j}\right)m/s$. Completes one revolution in T_0 time. Find the displacement (in m) of particle at time `(5T_(0))/(4).



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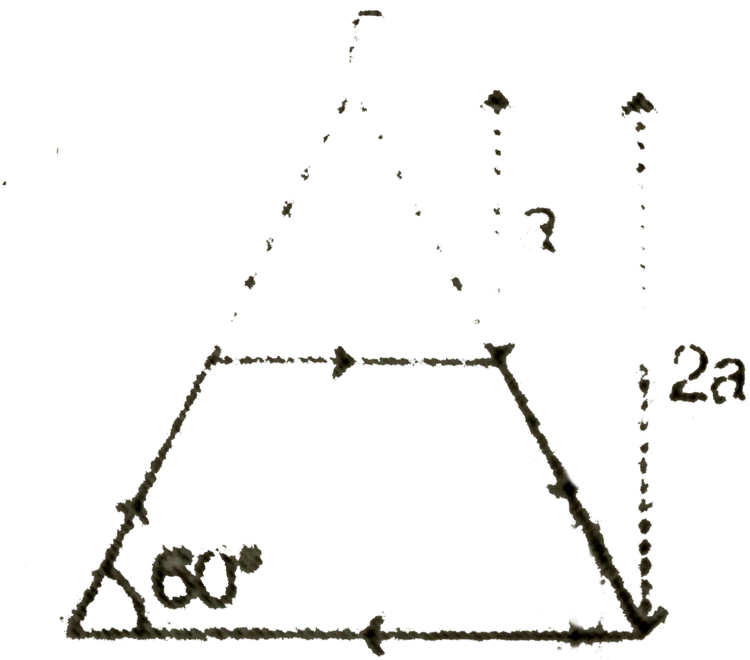
8. Figure shows a conducting loop in shape of a trapezium carrying a current $i = 10A$. Find the magnetic field $B(\in \mu T)$ at a point P. It is given that a=10 cm.



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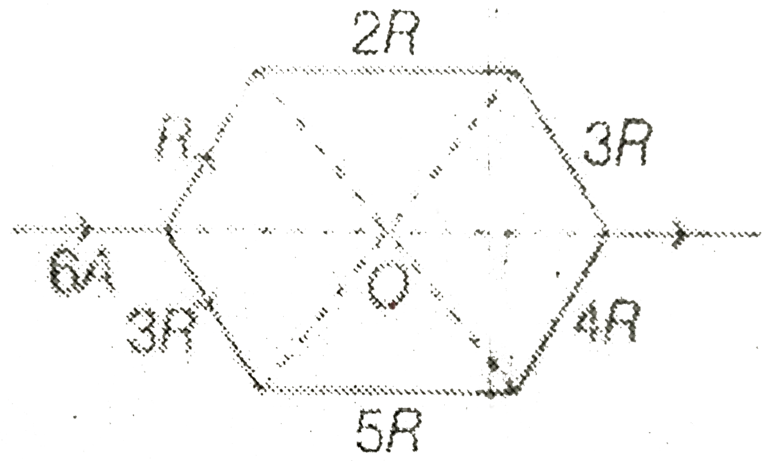
9. Side of the regular hexagon is 2 meter. Magnetic field at point O due to the network shown in the figure $\sqrt{3}B_0 \times 10^{-7}$ T. Find value of B_0



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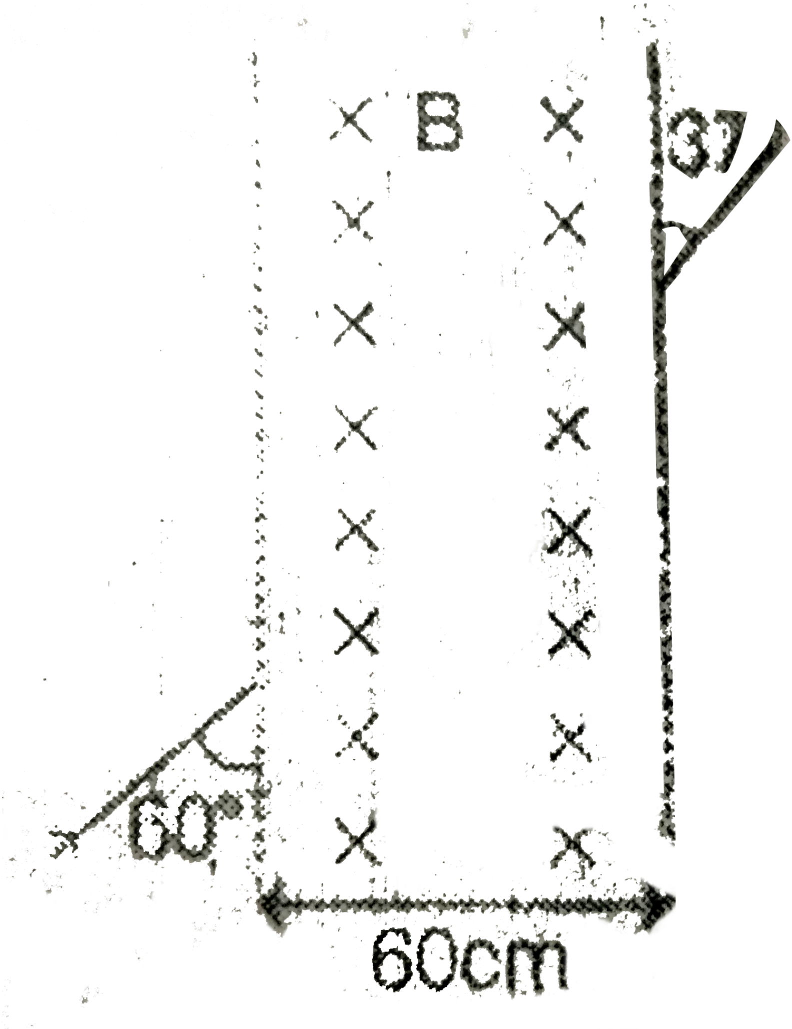
10. A positive charge particle enters and comes out (at 60° and 37° as shown) from a uniform magnetic field which is perpendicular to paper inwards in a finite space of width 60 cm as shown in the figure. Find the radius of curvature of the charged particle (in meter) when it is inside the magnetic field.



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