
PRAYAS
JEE 2025
Lecture - 05
Physics
Magnetism
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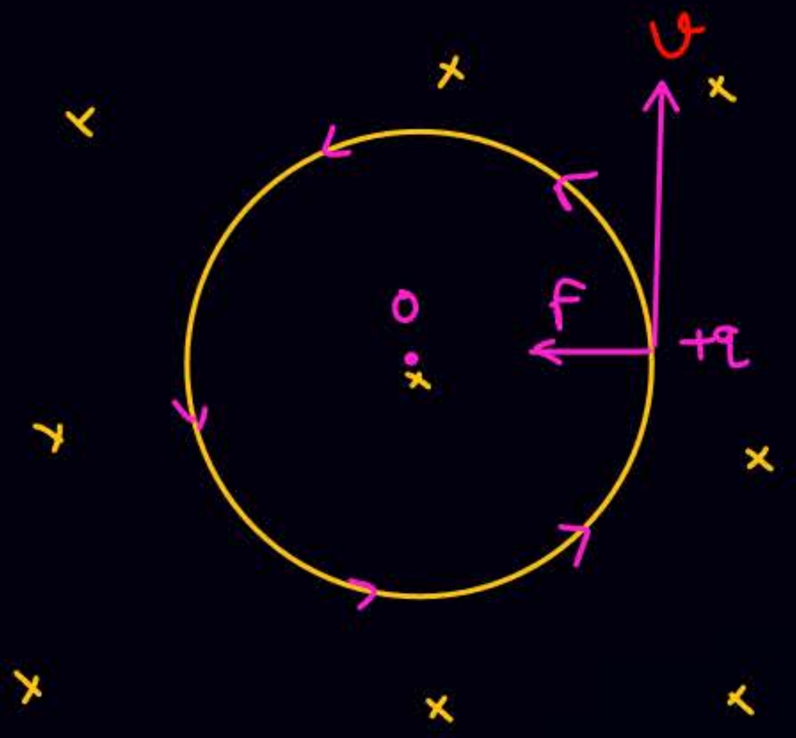
Topics *to be covered*

1. motion of charge particle inside magnetic field.
2.
3.
4.

#



$$F = qvB = \frac{mv^2}{R}$$

* $R = \frac{mv}{qB} = \frac{P}{qB} = \frac{\sqrt{2m(KE)}}{qB}$

* $T = \frac{2\pi R}{v} = \frac{2\pi m}{qB} \propto v^0$

* $\omega = \frac{qB}{m}$

* Uniform circular motion

Q find

① Radius $= R = \frac{mv}{qB}$

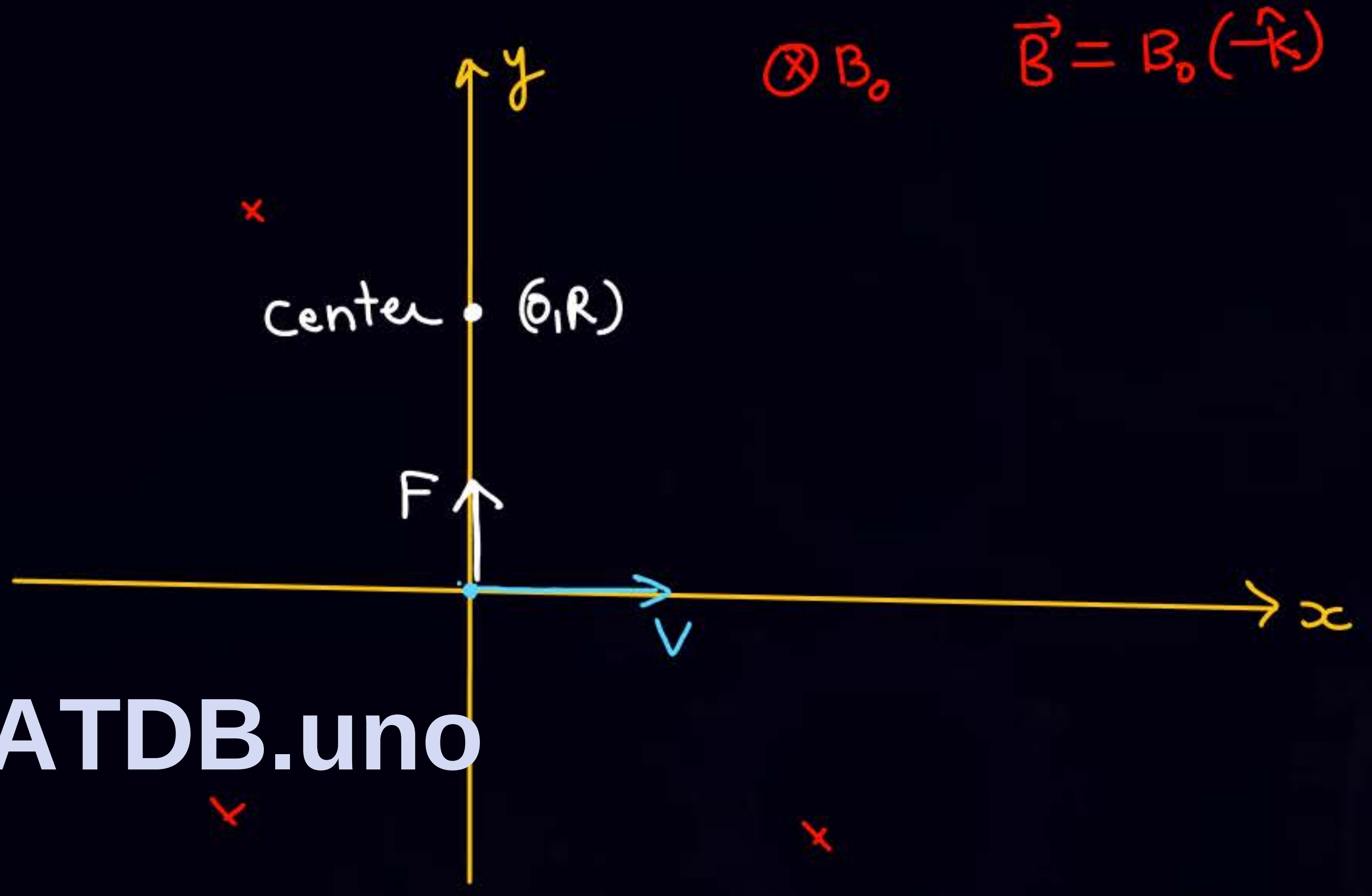
② $T = \frac{2\pi m}{qB}$, $\omega = \frac{qB}{m}$

③ Center $(0, R) = \left(0, \frac{mv}{qB}\right)$

④ $\vec{r} = f(t)$ → next page

⑤ $y_{max} = 2R = \frac{2mv}{qB}$

⑥ $v = f(t)$, $a = f(t)$



(4) $\vec{r} = f(t)$

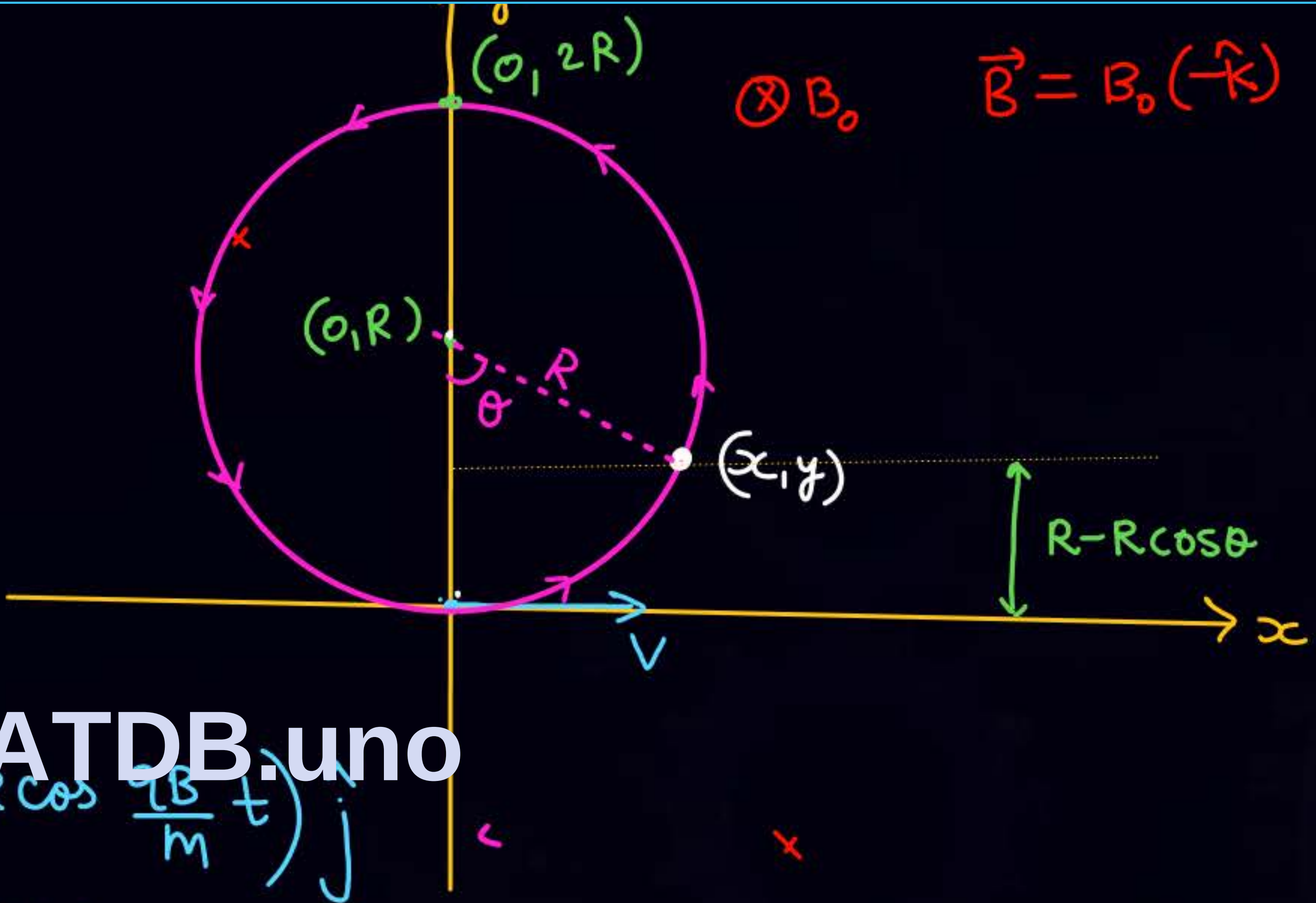
$$\vec{r} = x\hat{i} + y\hat{j}$$

$$x = R\sin\theta$$

$$y = R - R\cos\theta$$

$$\theta = \omega t$$

$$\theta = \frac{qB}{m}t$$



Style

$$\vec{r} = R\sin\left(\frac{qB}{m}t\right)\hat{i} + \left(R - R\cos\frac{qB}{m}t\right)\hat{j}$$

$$\vec{r} = R\sin\omega t\,\hat{i} + (R - R\cos\omega t)\hat{j}$$

$$\vec{v} = \frac{d\vec{r}}{dt} = R\omega\cos\omega t\,\hat{i} + R\omega\sin\omega t\,\hat{j}$$

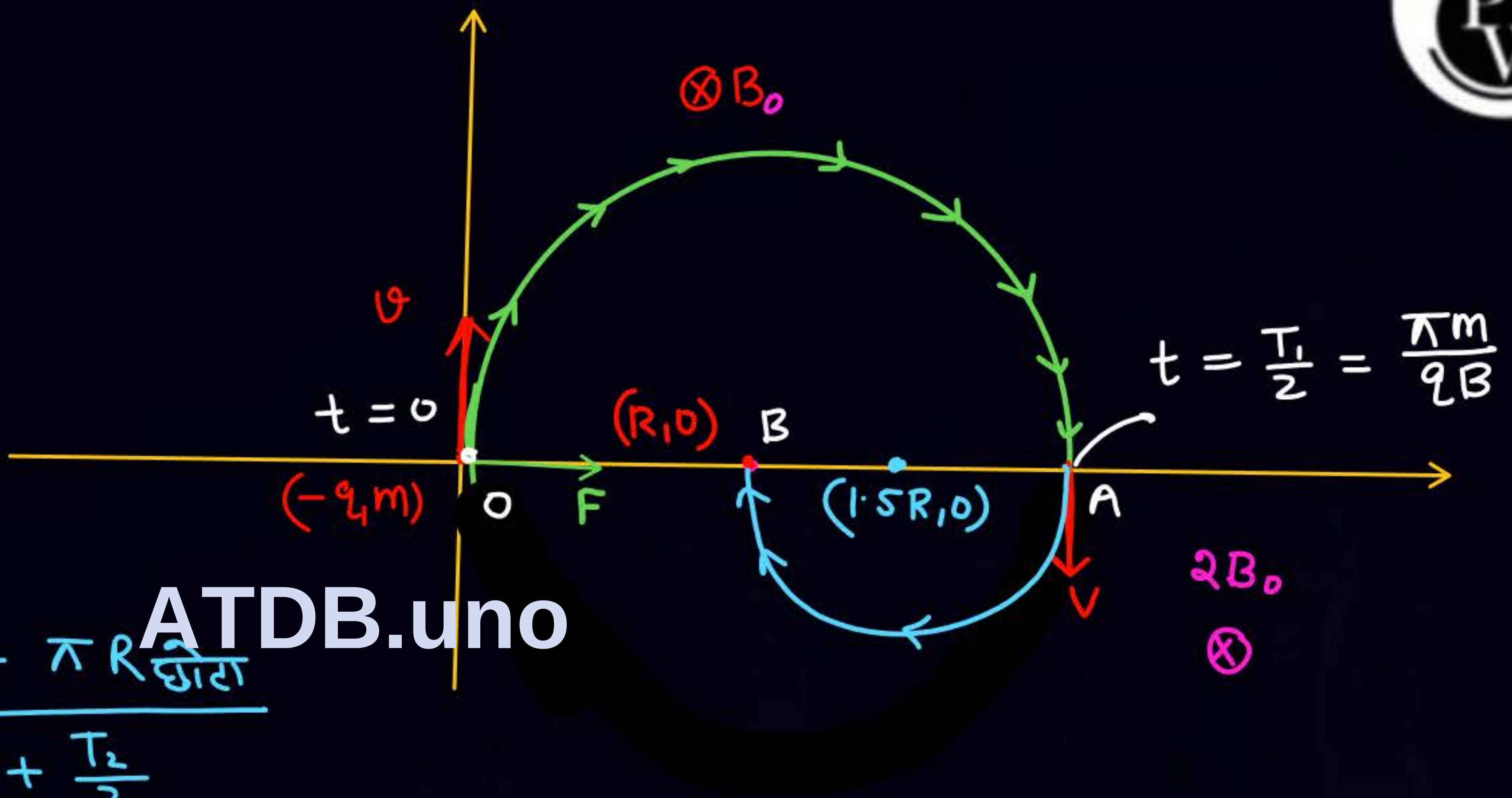
JA

Q

$$R = \frac{mv}{qB}$$

$$R_2 = R/2$$

O ⟶ A ⟶ B



$$\text{Avg speed} = \frac{\pi R_{\text{बड़ा}} + \pi R_{\text{छोटा}}}{\frac{T_1}{2} + \frac{T_2}{2}}$$

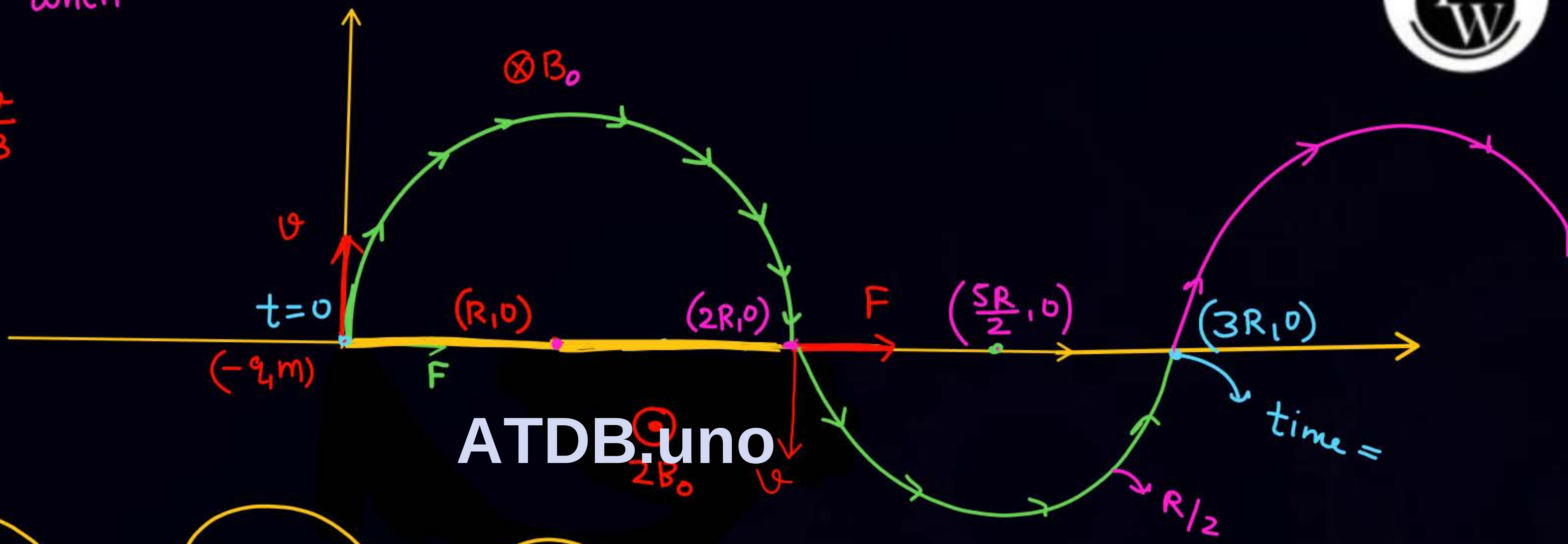
$$\text{Avg speed along x-Axis} = \frac{2R_1 + 2R_2}{\frac{T_1}{2} + \frac{T_2}{2}}$$

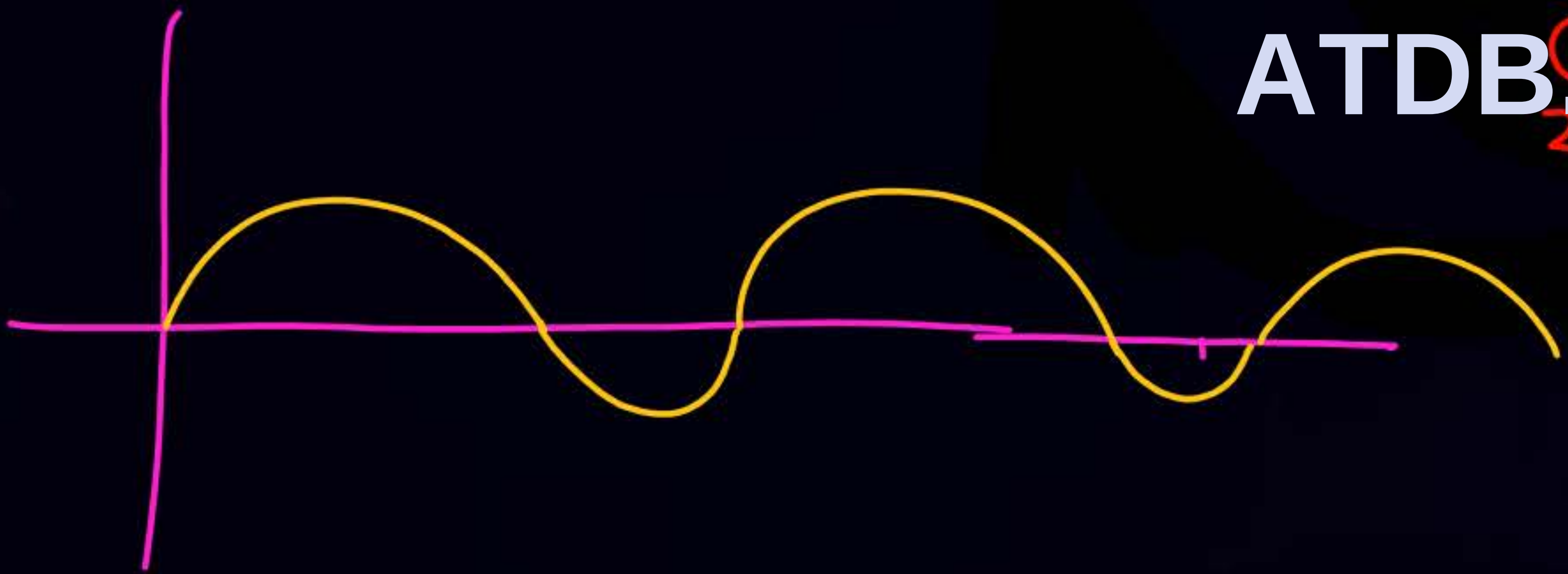
SSSQ

when

$R = \frac{mv}{qB}$

$R_2 = R/2$





Ans ⇒ $\frac{\pi m}{qB} + \frac{\pi m}{q(2B)}$

$\frac{T_1}{2} + \frac{T_2}{2}$ (Ans)

#

$\theta = 0$

$\bar{F} = q(\bar{v} \times \bar{B})$

$F = 0$

straight line.

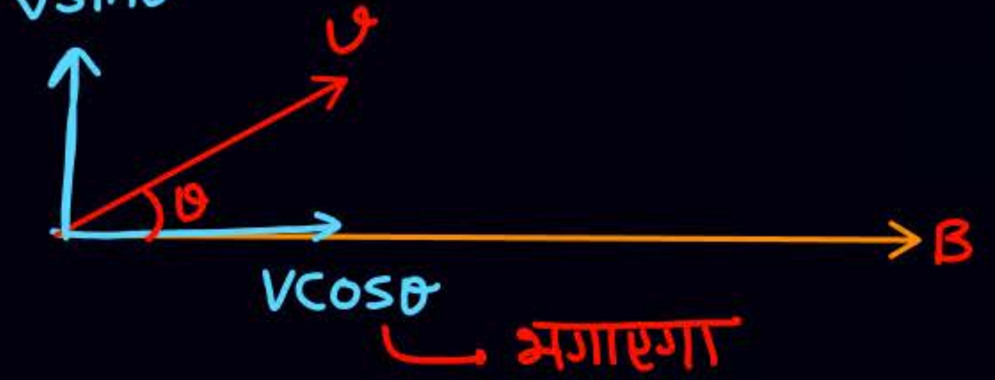
#

F → अंदर

$R = \frac{mv}{qB}$

Circular

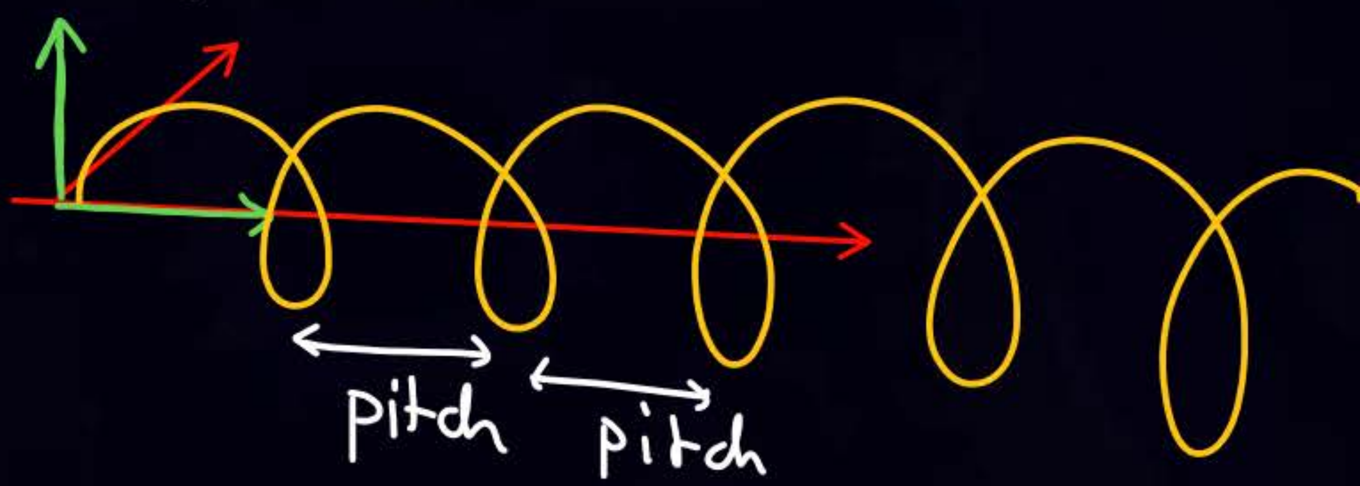
#



$R = \frac{mv\sin\theta}{qB}$

pitch = $V\cos\theta \times T$

(helical)



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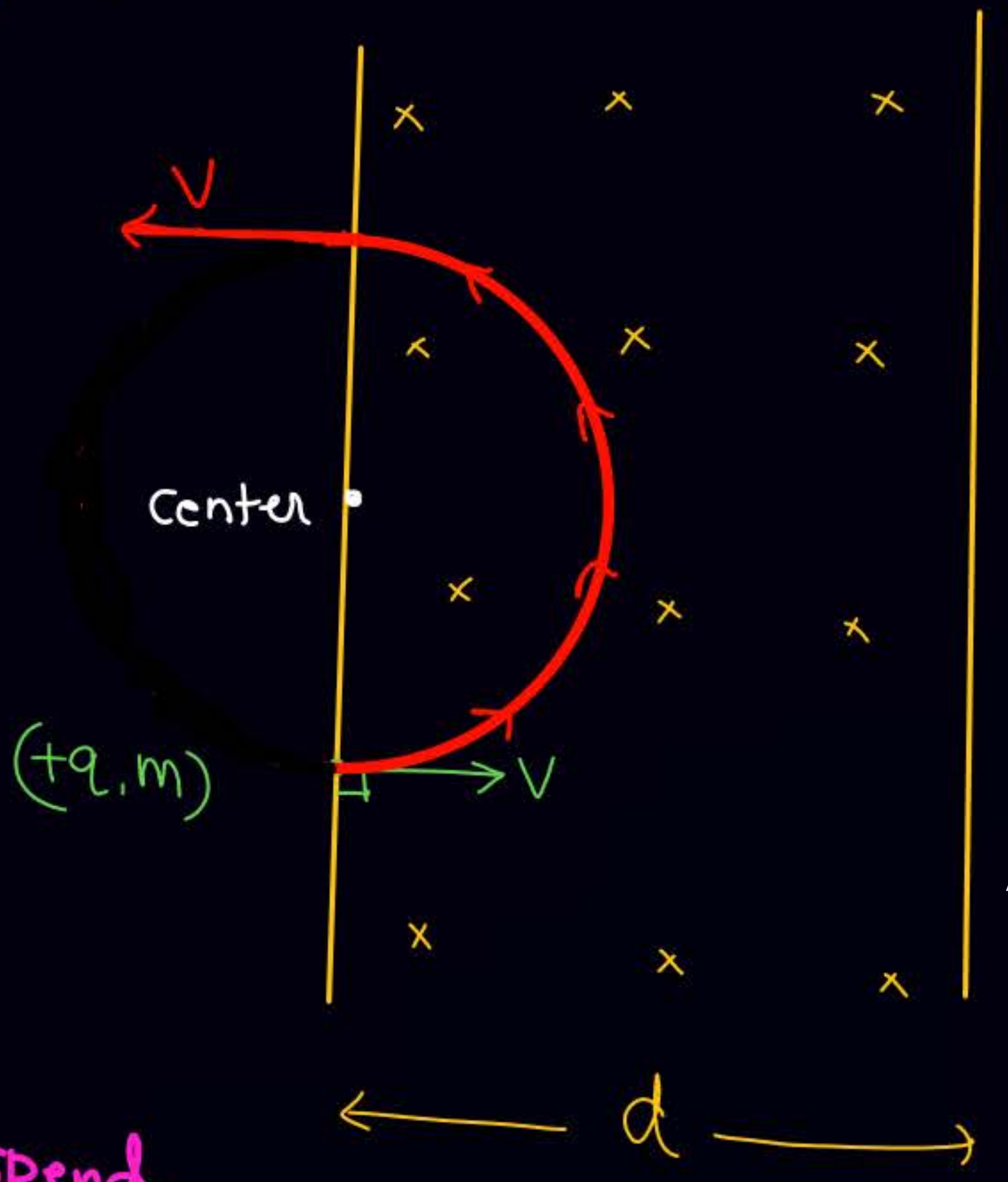
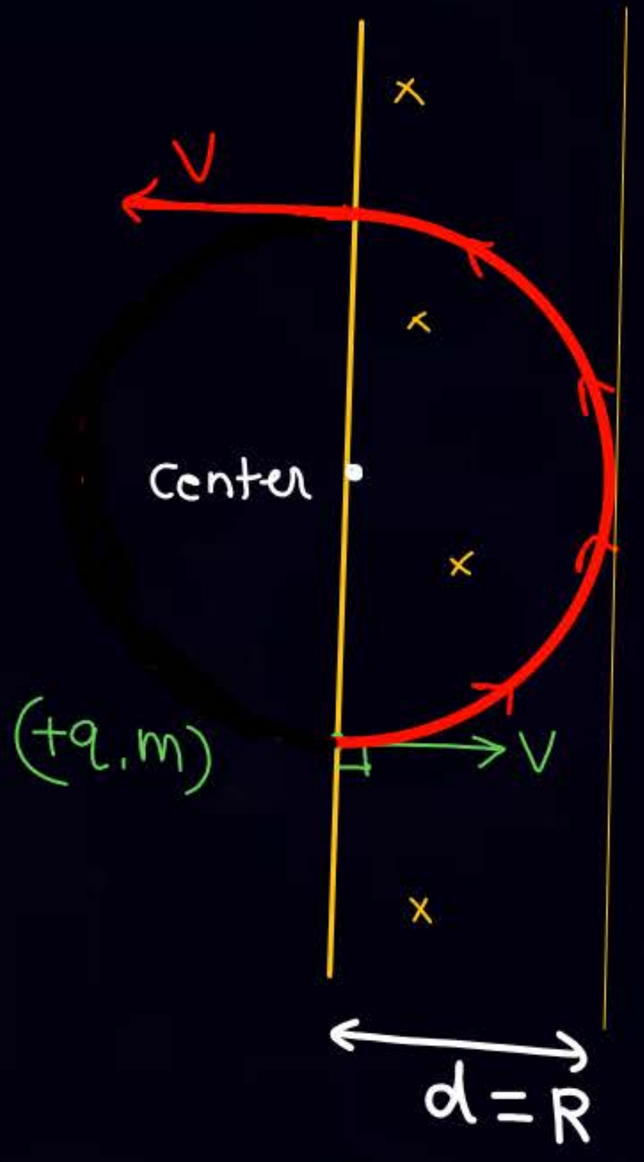


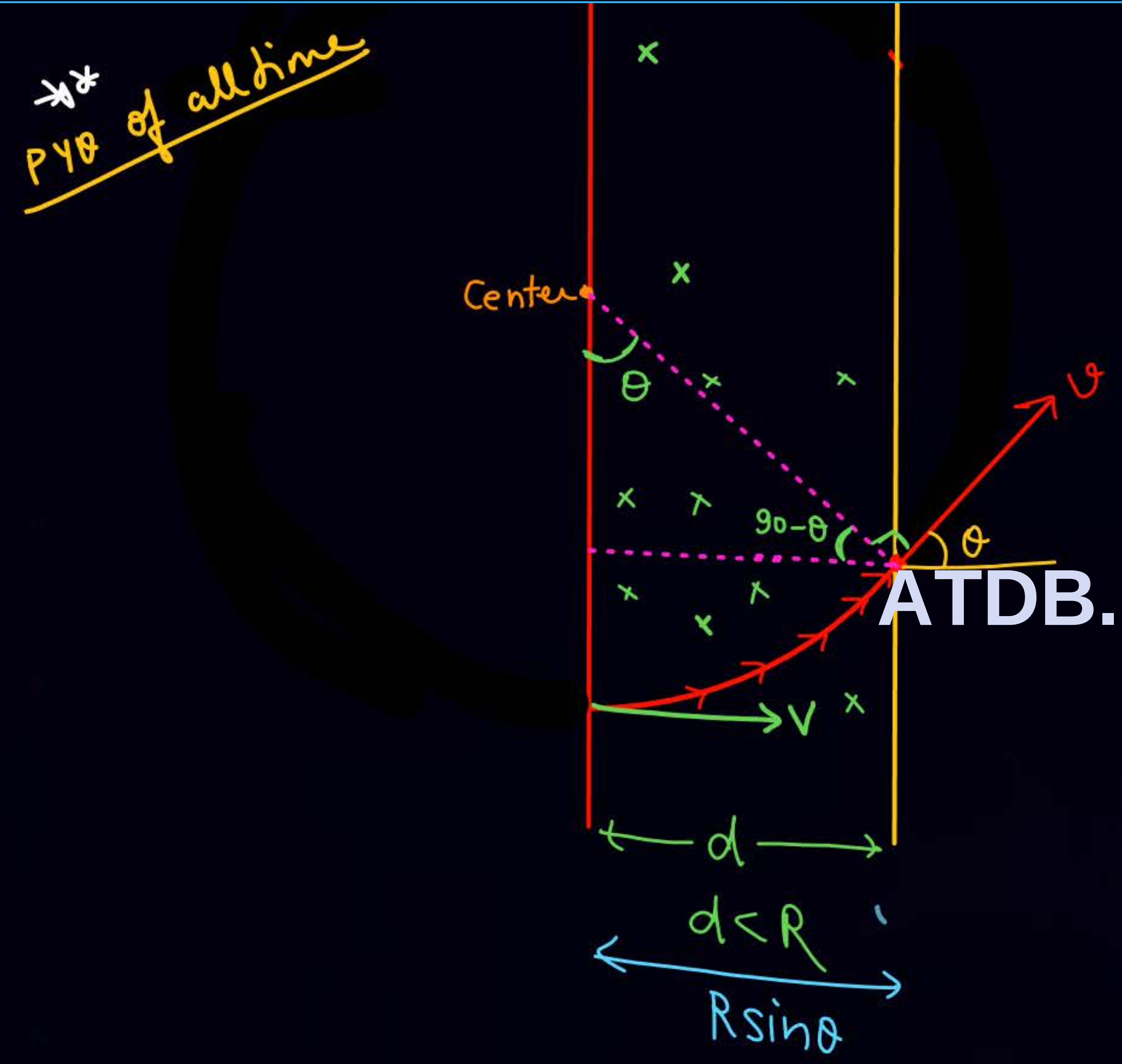
d > R (let)

* time spend in B = $\frac{\pi m}{qB}$

* $\Delta P = 2mv$

Case (2) $d = R$





$\theta \rightarrow$ Deviation

$\vec{v}_f = v\cos\theta\,\hat{i} + v\sin\theta\,\hat{j}$

$\vec{v}_i = v\,\hat{i}$

$\Delta\vec{v}$, $\Delta\vec{P}$ = ✓

** $R\sin\theta = d$

$\sin\theta = \dfrac{d}{R}$

Q

$\theta = 60^\circ$ (Let)

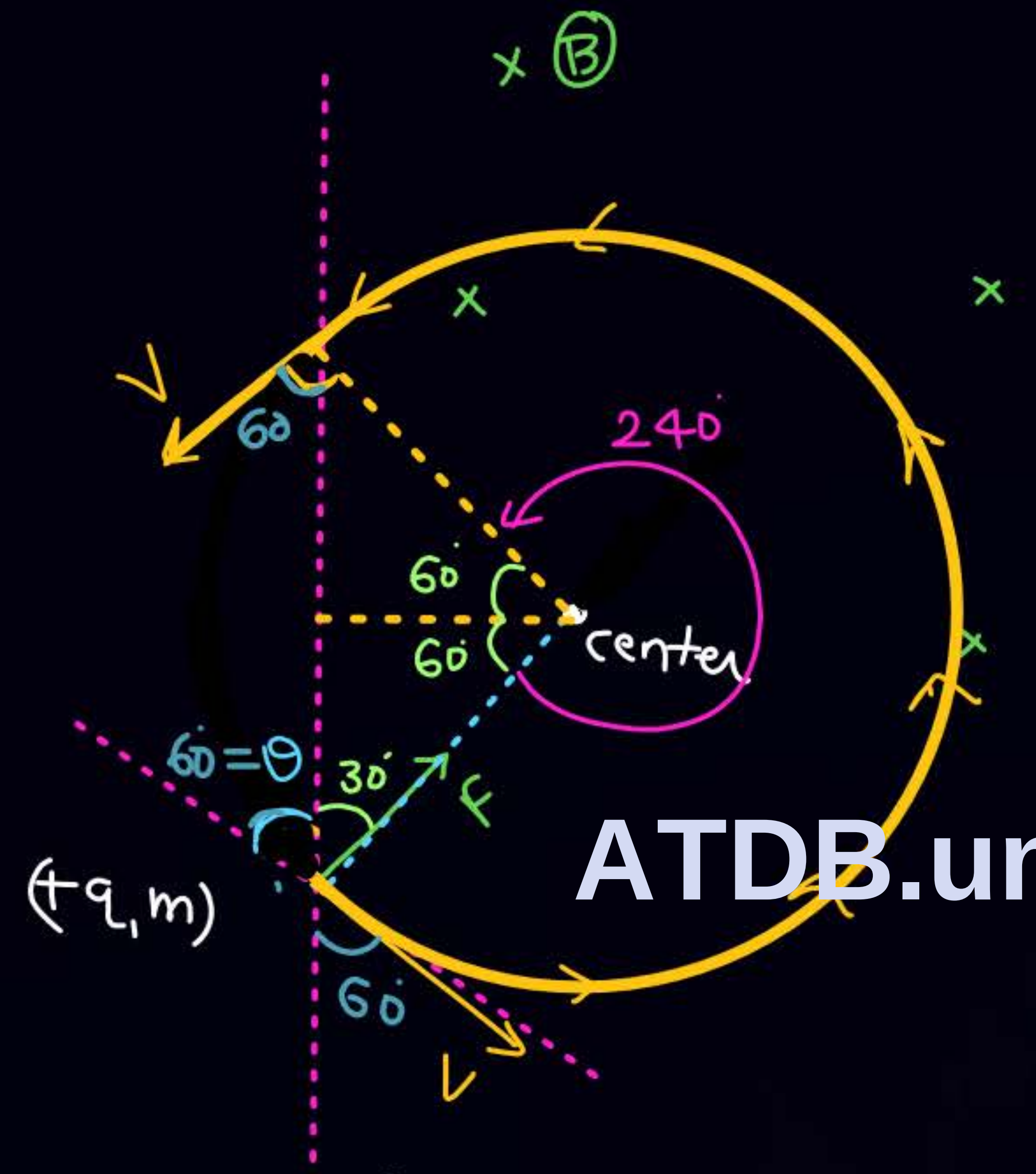
(4) $\Delta \vec{P} = ?$

$\vec{v}_i = v\sin 60\,\hat{i} - v\cos 60\,\hat{j}$

$\vec{v}_f = -v\sin 60\,\hat{i} - v\cos 60\,\hat{j}$

$\Delta \vec{v} = \vec{V}_f - \vec{V}_i = -2v\sin 60\,\hat{i}$

$\Delta \vec{p} = -2mv\sin 60\,\hat{i}$



(1) angle rotated by radius vector inside B = 240°

(2) time spend in B = 2T/3

(3) Distance travel inside 'B' $= v \cdot 2T/3$

$360^\circ \longrightarrow T$

$1 \longrightarrow \frac{T}{360^\circ}$

$240^\circ \longrightarrow \frac{T}{360} \times 240 = 2T/3$

$\theta = \frac{arc}{R}$

$arc = \theta \times R = \frac{4\pi}{3} \cdot R$

Q

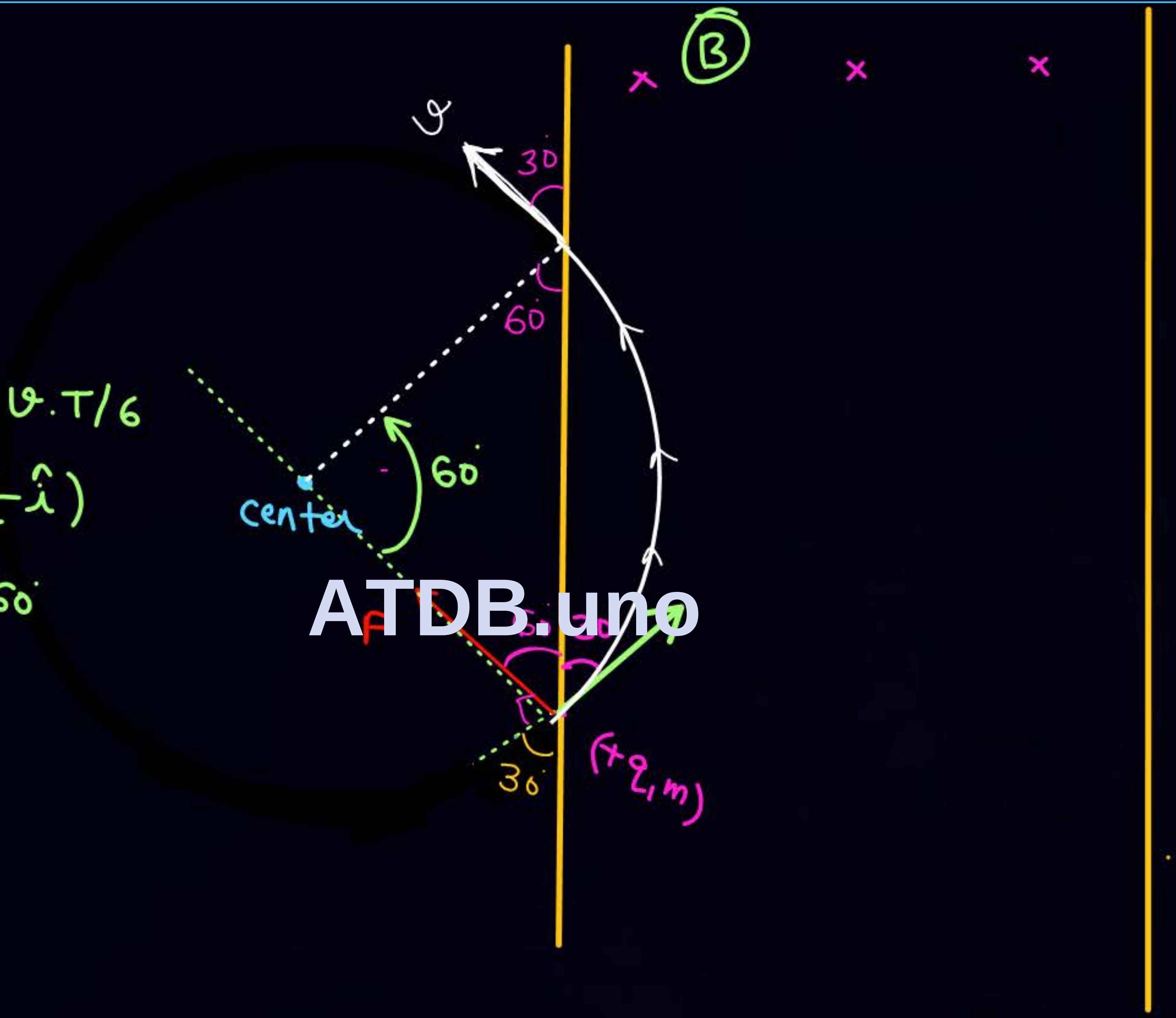
① $R = \frac{mv}{qB}$

② Time spend in $\vec{B}$ = T/6

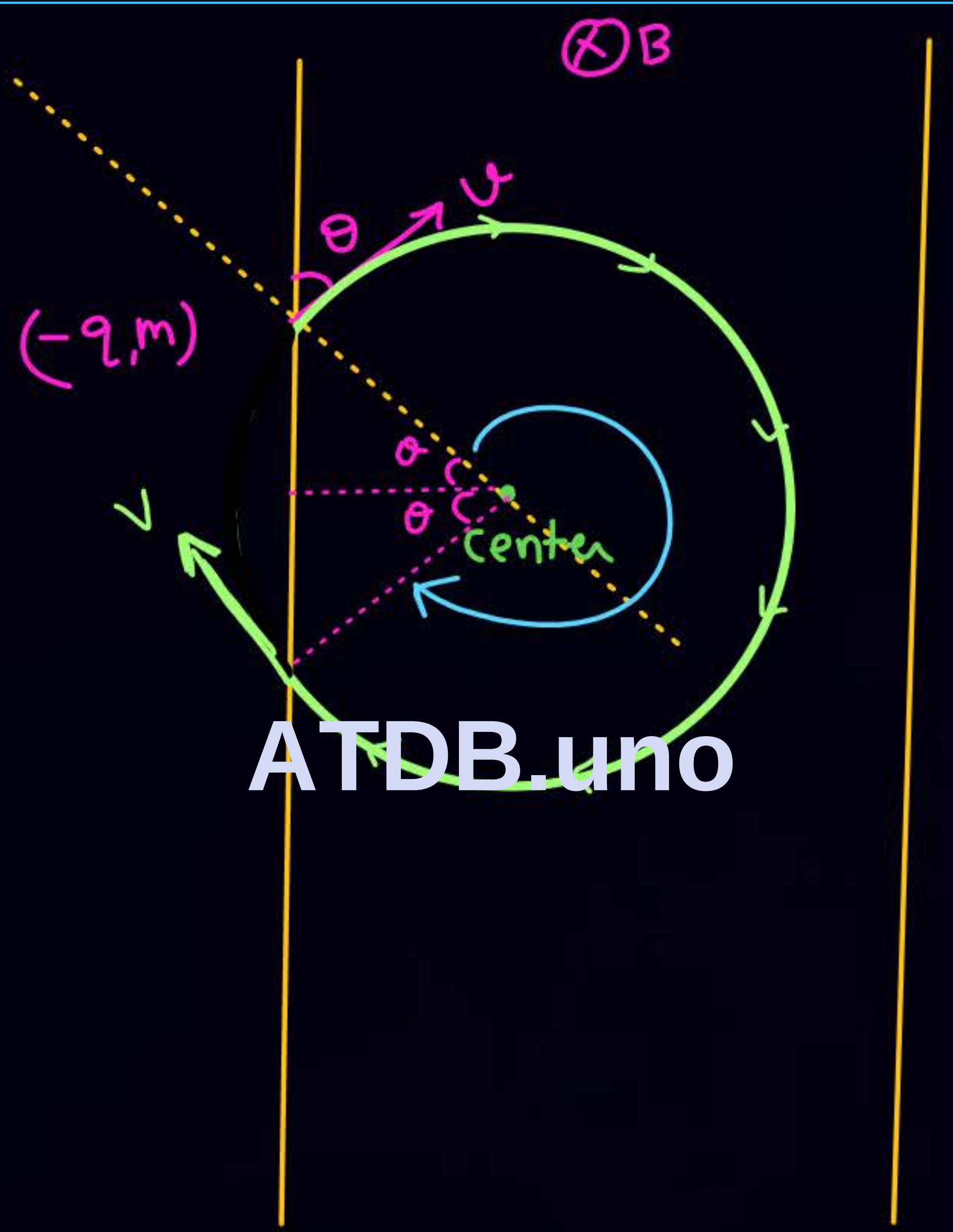
③ Distance travel in $\vec{B}$ = v.T/6

④ $\Delta \vec{P} = 2mv\sin 30\ (-\hat{i})$

⑤ Angle rotated by $\vec{r}$ ≡ 60°



Q



$2\pi - 2\theta$ घूमेगा

imp Data for JEE mains ques

proton $(m, +e)$

α particle $(4m, +2e)$

Deuterium $(2m, +e)$

electron $(m_e, -e)$

$$r = \frac{mv}{qB} = \frac{p}{qB} = \frac{\sqrt{2m(K.E)}}{qB}$$

Q $\frac{r_\alpha}{r_{Proton}} = ?$ if they have same K.E in Uniform $\vec{B}$

$$r \propto \frac{\sqrt{m}}{q}$$

$$\frac{r_\alpha}{r_p} = \sqrt{\frac{m_\alpha}{m_p}} \times \frac{q_p}{q_\alpha}$$

$$= \sqrt{\frac{4m}{m}} \cdot \frac{e}{2e}$$

$$= 1$$

(b) If they have same magnitud of momentum

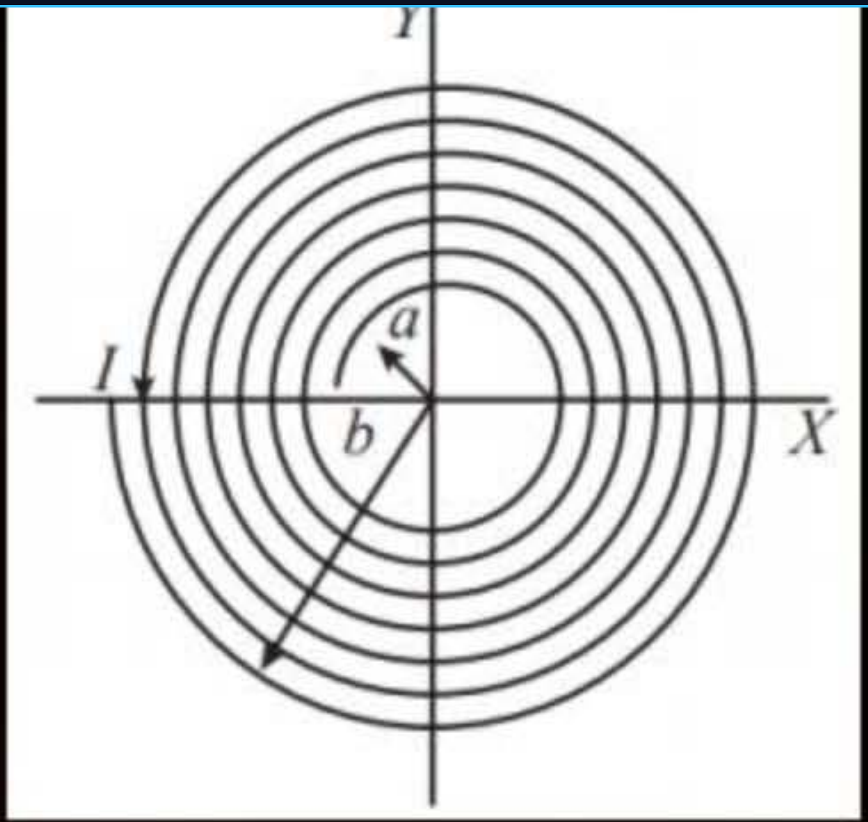
$$r \propto \frac{1}{q}$$

$$\frac{r_\alpha}{r_p} = \frac{e}{2e} = \frac{1}{2}$$


@SALEEMSIR_PW

Q. 1 A long insulated copper wire is closely wound as a spiral of N turns. The spiral has inner radius a and outer radius b. The spiral lies in the $X-Y$ plane and a steady current I flows through the wire. The Z-component of the magnetic field at the centre of the spiral is

(IIT-JEE 2011)



(a) $\frac{\mu_0 NI}{2(b-a)} ln\left(\frac{b}{a}\right)$

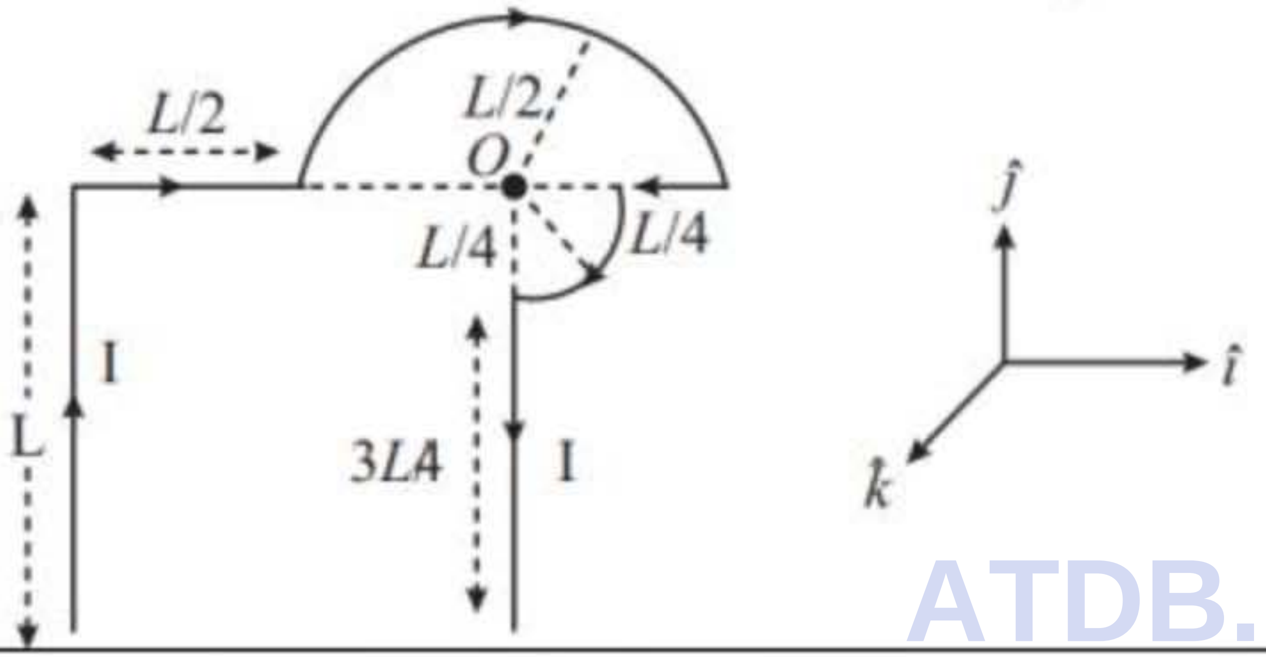
(b) $\frac{\mu_0 NI}{2(b-a)} ln\left(\frac{b+a}{b-a}\right)$

(c) $\frac{\mu_0 NI}{2b} ln\left(\frac{b}{a}\right)$

(d) $\frac{\mu_0 NI}{2b} ln\left(\frac{b+a}{b-a}\right)$

Ans : (a)

Q. 4 Which one of the following options represents the magnetic field $\vec{B}$ at O due to the current flowing in the given wire segments lying on the xy plane? **(JEE Adv. 2022)**



(a) $\vec{B} = \frac{-\mu_o I}{L}\left(\frac{3}{2} + \frac{1}{4\sqrt{2}\pi}\right)\hat{k}$ (b) $\vec{B} = -\frac{\mu_o I}{L}\left(\frac{3}{2} + \frac{1}{2\sqrt{2}\pi}\right)\hat{k}$

(c) $\vec{B} = \frac{-\mu_o I}{L}\left(1 + \frac{1}{4\sqrt{2}\pi}\right)\hat{k}$ (d) $\vec{B} = \frac{-\mu_o I}{L}\left(1 + \frac{1}{4\pi}\right)\hat{k}$

Ans : (c)

Solution 4

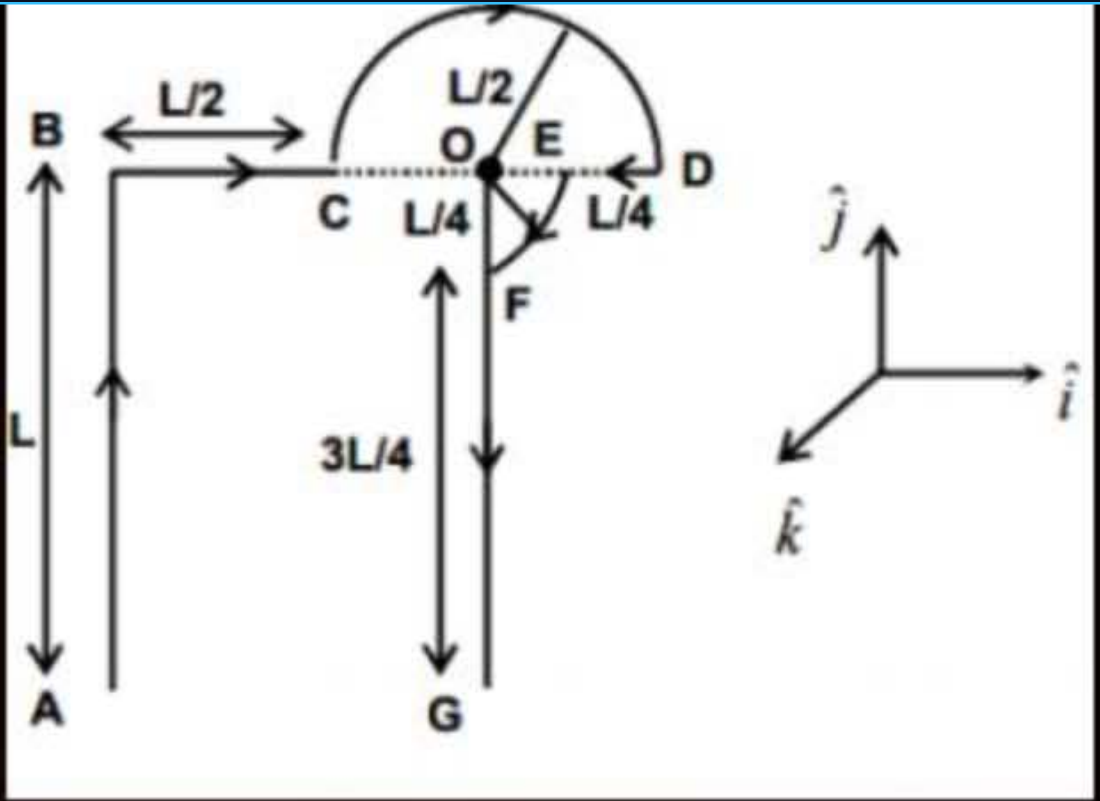
$$\vec{B}_{Net} = \vec{B}_{AB} + \vec{B}_{BC} + \vec{B}_{CD} + \vec{B}_{DE} + \vec{B}_{EF} + \vec{B}_{FG}$$

$$\vec{B}_{AB} = \vec{B}_{DE} = \vec{B}_{FG} = 0$$

$$\vec{B}_{AB} = \frac{\mu_0 I}{4\pi L}\sin 45^\circ\left[-\hat{k}\right]$$

$$\vec{B}_{CD} = \frac{\mu_0 I}{4\left(\frac{L}{2}\right)}\left[-\hat{k}\right]$$

$$\vec{B}_{EF} = \frac{\mu_0 I}{8\left(\frac{L}{4}\right)}\left[-\hat{k}\right] \Rightarrow (C)$$



Q. 6 Two parallel wires in the plane of the paper are distance x_0 apart. A point charge is moving with speed u between the wires in the same plane at a distance x_1 from one of the wires. When the wires carry current of magnitude I in the same direction, the radius of curvature of the path of the point charge is R_1. In contrast, if the currents I in the two wires have directions opposite to each other, the radius of curvature of the path is R_2. If $\frac{x_0}{x_1} = 3$, and value of $\frac{R_1}{R_2}$ is

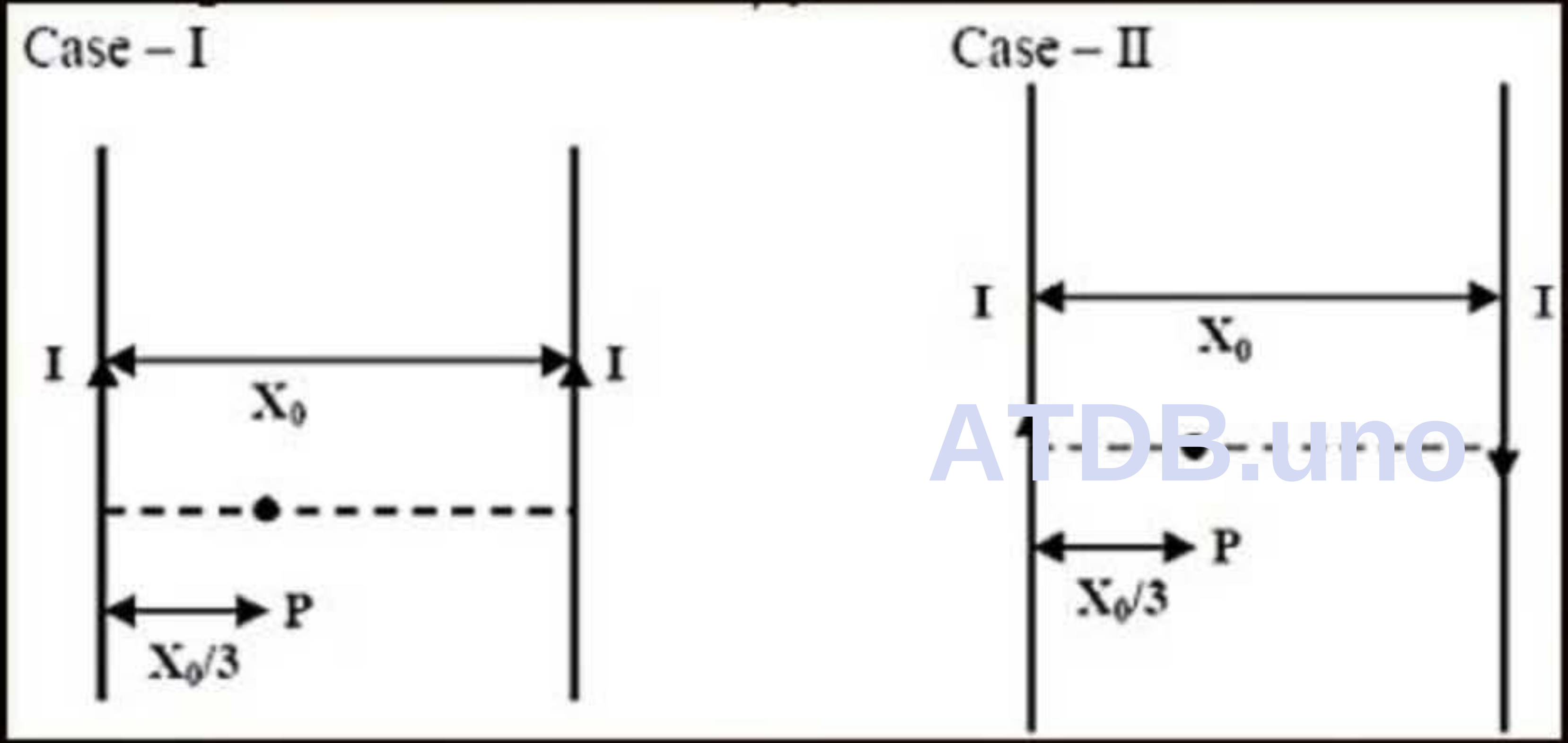
(JEE Adv. 2014)

Ans : (3)

Solution 6

$$B_1 = \frac{1}{2}\left(\frac{\mu_0}{2\pi}\right)\left(\frac{3I}{x_0}\right) \quad R_2 = \frac{mv}{qB_2}$$

$$R_1 = \frac{mv}{qB_1} \Rightarrow \frac{R_1}{R_2} = \frac{B_2}{B_1} = \frac{1/3}{1/9} = 3$$



Q. 7 An electron and a proton are moving on straight parallel paths with same velocity. They enter a semi-infinite region of uniform magnetic field perpendicular to the velocity. Which of the following statement(s) is/are true? **(IIT-JEE 2011)**

(*a*) They will never come out of the magnetic field region

(*b*) They will come out travelling along parallel paths

(*c*) They will come out at the same time

(*d*) They will come out at different times

Ans : (b, d)

Solution 7

By diagram B is true

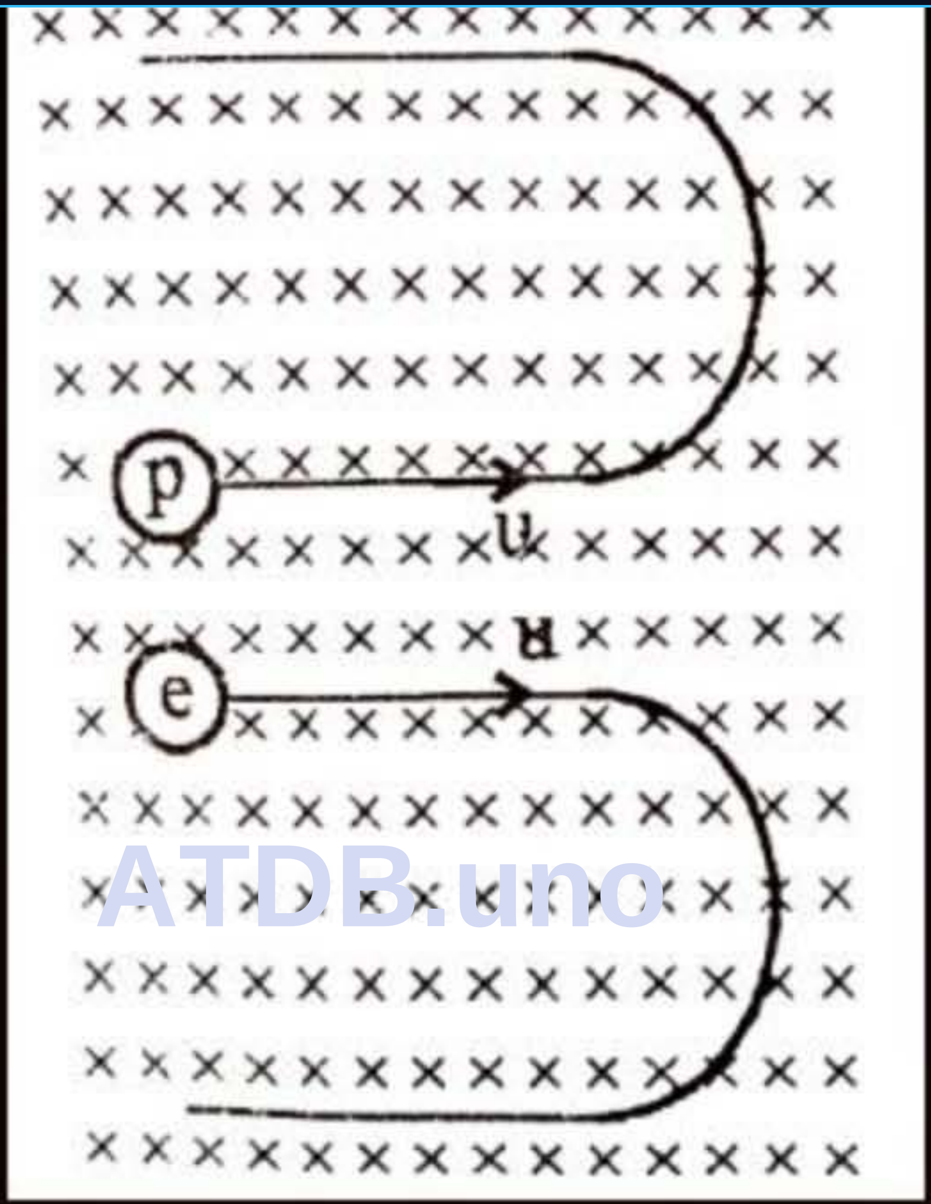
$$T = \frac{2\pi m}{qB}$$

$$t \propto m$$

$$m_p > m_e$$

$$T_p > T_e$$

So, D is also true



Q. 8 Ail α-particle (mass 4 amu) and a singly charged sulfur ion (mass 32 amu) are initially at rest. They are accelerated through a potential V and then allowed to pass into a region of uniform magnetic field which is normal to the velocities of the particles. Within this region, the α-particle and the sulfur ion move in circular orbits of radii r_α and r_s, respectively. The ratio (r_s/r_α) is_________.

(JEE Adv. 2021)

Ans : (4)

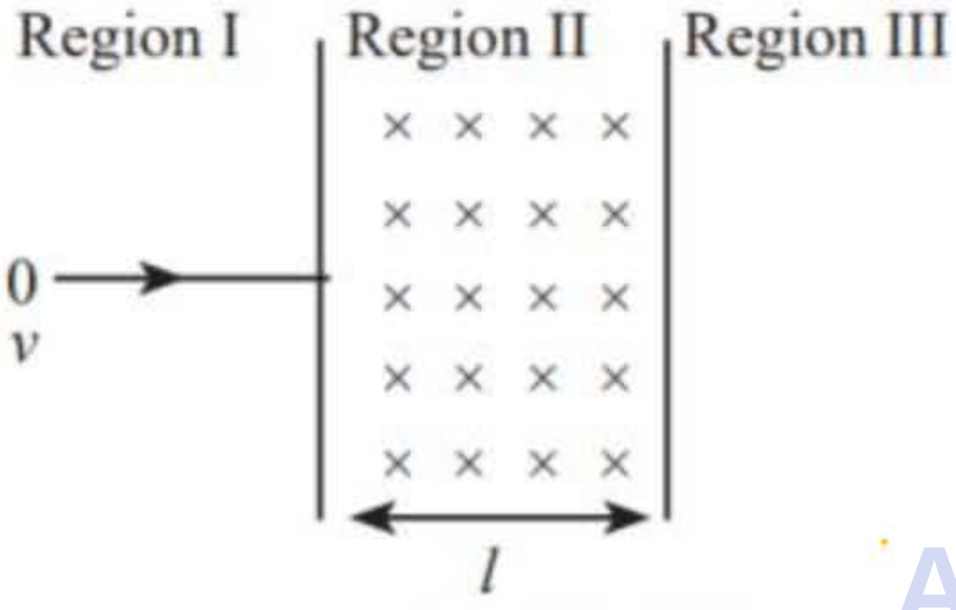
Solution 8

For a charged particle projected into uniform magnetic field, radius of path is given by

$$r = \frac{\sqrt{2mqV}}{qB} \Rightarrow r \propto \sqrt{\frac{m}{q}}$$

$$\Rightarrow \frac{r_s}{r_\alpha} = \sqrt{\frac{m_s}{m_\alpha}\left(\frac{q_\alpha}{q_s}\right)} = \sqrt{\frac{32(2)}{4(1)}} = 4$$

Q. 9 A particle of mass m and charge q, moving with velocity v enters Region II normal to the boundary as shown in the figure. Region II has a uniform magnetic field B perpendicular to the plane of the paper. The length of the Region II is l. Choose the correct choice (s)



(IIT JEE 2008)

(a) The particle enters Region III only if its velocity $v > \frac{qlB}{m}$

(b) The particle enters Region III only if its Velocity $v < \frac{qlB}{m}$

(c) Path length of the particle in Region II is maximum when velocity $v = qlB/m$

(d) Time spent in Region II is same for any velocity v as long as the particle returns to Region I

Ans : (a, c, d)

Solution 9

As the particle enters region II, it will have a portion of circular path in this region.

$$r = \frac{mv}{qB}$$

If the width of the region l is less than r, the particle will enter region III.

$$\therefore \frac{mv}{qB} > l$$

$$\Rightarrow v > \frac{qBl}{m}$$

$\therefore$ the path length of the particle in region II will be maximum

when $l = r$ i.e $v = \dfrac{qlB}{m}$

when $r = l$, time spent in the region II is $\dfrac{T}{2} = \dfrac{1}{2}\dfrac{2\pi m}{qB} = \dfrac{\pi m}{qB}$.

Time is independent of speed

Q. 11 A particle of mass M and positive charge Q, moving with a constant velocity $\vec{u}_1 = 4\hat{i}\ \text{ms}^{-1}$, enters a region of uniform static magnetic field normal to the $x-y$ plane. The region of the magnetic field extends from $x = 0$ to $x = L$ for all values of y. After passing through this region, the particle emerges on the other side after 10 milliseconds with a velocity $\vec{u}_2 = 2\left(\sqrt{3}\hat{i} + \hat{j}\right)\text{ms}^{-1}$. The correct statement(s) is/are **(JEE Adv. 2013)**

(a) The direction of the magnetic field is $-z$ direction.

(b) The direction of the magnetic field is $+z$ direction

(c) The magnitude of the magnetic field is $\dfrac{50\pi M}{3Q}$ units

(d) The magnitude of the magnetic field is $\dfrac{100\pi M}{3Q}$ units

Ans : (a, c)

Solution 11

Correct Answer - A::C

Refer to figure, component of final velocity of particle is in positive y-direction. The centre of circular path of particle in magnetic field is present on positive y-direction So magnetic field is present in negative z-direction.

If θ is the angle of deviation of the particle with x-axis while emerging from magnetic field, then

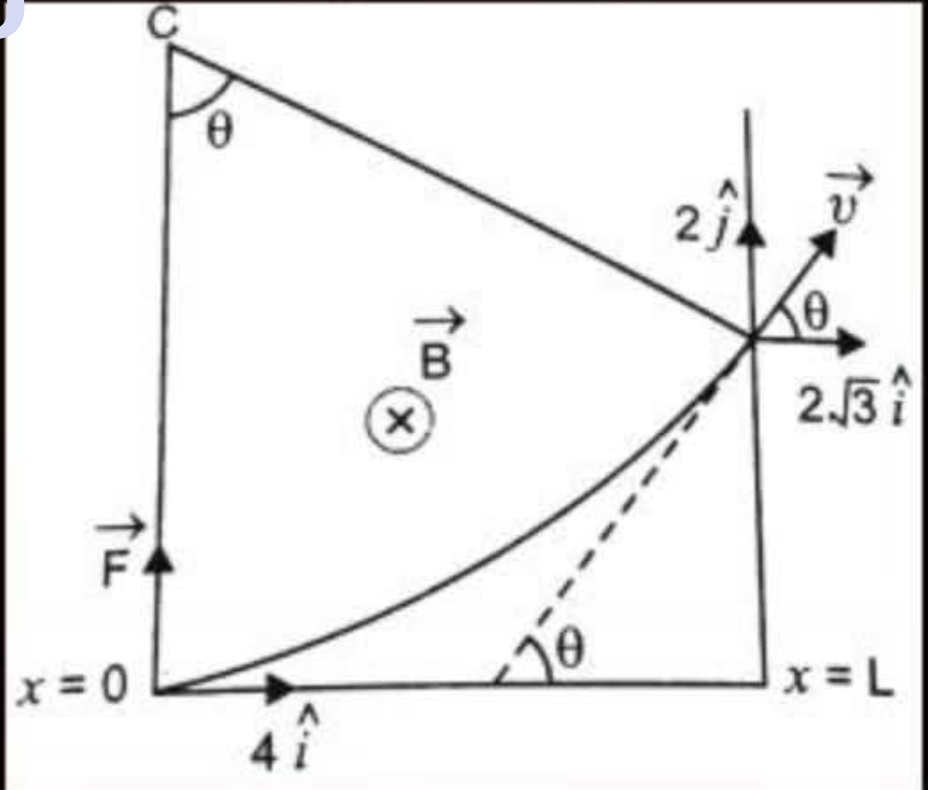
$$\tan\theta = \frac{v_y}{v_x} = \frac{2}{2\sqrt{3}} = \frac{1}{\sqrt{3}} = \frac{\tan\pi}{6} \text{ or } \theta = \frac{\pi}{6}$$

Angular velocity of rotation of particle in magnetic field, $\omega = \frac{QB}{M}$

Time taken by particle to cross the magnetic field is

$$t = \frac{\theta}{\omega} = \frac{\pi/6}{QB/M} = \frac{M\pi}{6QB}$$

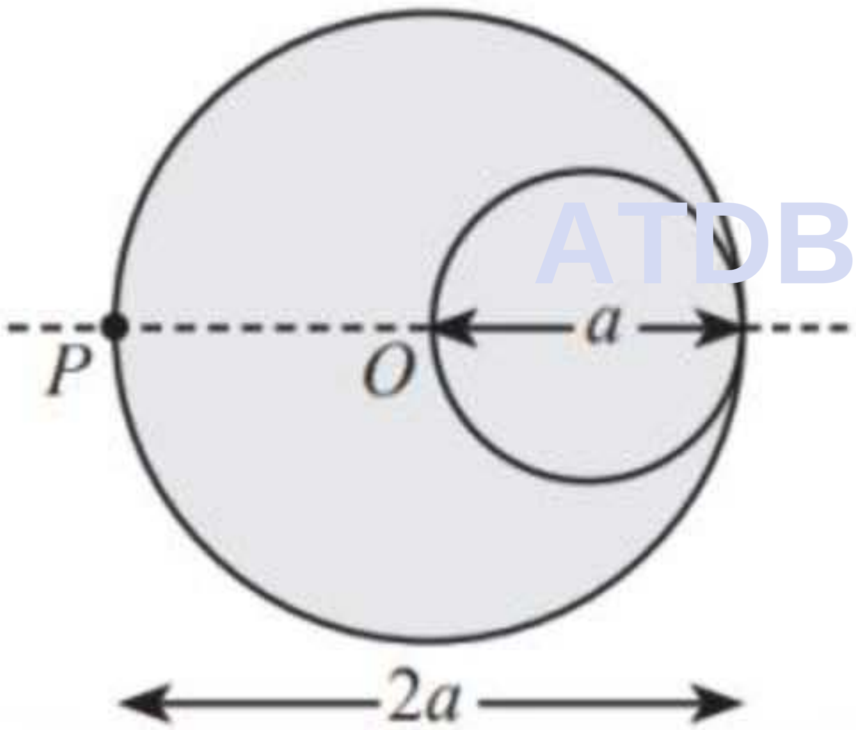
$$\text{or } B = \frac{M\pi}{6Qt} = \frac{M\pi}{6Q \times (10 \times 10^{-3})} = \frac{50M\pi}{3Q}$$



Q. 17 A cylindrical cavity of diameter a exists inside a cylinder of diameter $2a$ as shown in the figure. Both the cylinder and the cavity are infinitely long. A uniform current density J flows along the length.

If the magnitude of the magnetic field at the point P is given by $\frac{N}{12}\mu_0 a.J$, then the value of N is

(IIT-JEE 2012)



Ans : (5)

Solution 17

The magnetic field for an infinitely long cylinder is given by,

$$B_{in} = \frac{\mu_o J r}{2}$$

$$B_{out} = \frac{\mu_o J R^2}{2r}$$

r = distance from the axis of the cylinder.

R = Radius of the cylinder.

Assuming the bigger cylinder to carry a positive current density and the smaller cylinder carry a negative current density of magnitude J each.

$\therefore$ Magnetic field at point P = $B = B_1 + B_2$

$$B_1 = \frac{\mu_o J a}{2}$$

$$B_2 = \frac{-\mu_o J\left(\frac{a}{2}\right)^2}{2\frac{3a}{2}}$$

$$\therefore B_2 = \frac{-\mu_o J a}{12}$$

$$\therefore B = \frac{5\mu_o J a}{12}. \qquad \therefore N = 5$$

Q. 21 In a particular system of units, a physical quantity can be expressed in terms of the electric charge e, electron mass m_e, Planck's constant h, and Coulomb's constant k $= \frac{1}{4\pi\varepsilon_0}$, where ε_0 is the permittivity of vacuum. In terms of these physical constants, the dimension of the magnetic field is $[B] = [e]^{\alpha} [m_e]^{\beta} [h]^{\gamma} [k]^{\delta}$. The value of $\alpha + \beta + \gamma + \delta$ is ________. [JEE-Advance-2022]

Ans : (4)

Solution 21

$$[B] = [e]^{\alpha} [M_e]^{\beta} [h]^{\gamma} [K]^{\delta}$$

$$[B] = MT^{-2}I^{-1}$$

$$[e] = I^{T}$$

$$[h] = ML^{2}\,T^{-1}$$

$$[K] = ML^{3}\,T^{-4}\,I^{-2}$$

$$MT^{-2}I^{-1} = [IT]^{\alpha}\,[M]^{\beta}$$

$$[ML^{2}T^{-1}]^{\gamma}\,[ML^{3}T^{-4}I^{-2}]^{\delta}$$

$$1 = \beta + \gamma + \delta \qquad (1)$$

$$-2 = \alpha - \gamma - 4\delta \qquad (2)$$

$$-1 = \alpha - 2\delta \qquad (3)$$

$$0 = 2\gamma + 3\delta \qquad (4)$$

On solving equation (1), (2), (3) and (4), we get

$$\alpha = 3$$

$$\gamma = -3$$

$$\delta = 2$$

$$\beta = 2$$

$$\alpha + \beta + \gamma + \delta = 4$$

Q. 22 A dimensionless quantity is constructed in terms of electronic charge e, permittivity of free space ε_0, Planck's constant h, and speed of light c. If the dimensionless quantity is written as $e^{\alpha}\varepsilon_0^{\beta}h^{\gamma}c^{\delta}$ and n is a non-zero integer, then $(\alpha, \beta, \gamma, \delta)$ is given by

JEE Adv. 2024

(A) (2n, -n, -n, -n)

(B) (n, -n, -2n, -n)

(C) (n, -n, -n, -2n)

(D) (2n, -n, -2n, -2n)

Ans : (A)

Solution 22

For the quantity to be dimensionless

$$e^{\alpha}\varepsilon_0^{\beta}h^{\gamma}c^{d} = M^0\,L^0\,T^0\,A^0$$

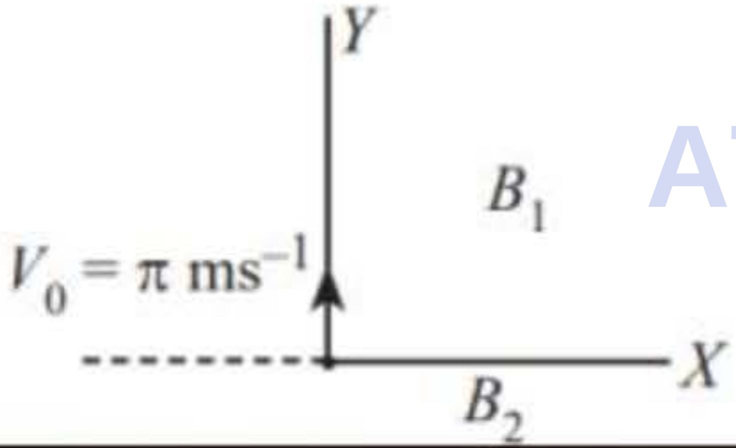
$$\Rightarrow (AT)^{\alpha}\left(M^{-1}\,L^{-3}\,T^4\,A^2\right)^{\beta}\left(ML^2\,T^{-1}\right)^{\gamma}\left(LT^{-1}\right)^{\delta} = A^0M^0\,L^0\,T^0$$

$$\therefore \alpha+2\beta=0, \alpha+4\beta-\gamma-\delta=0, -\beta+\gamma=0 \,\&\, -3\beta+2\gamma+\delta=0$$

$$\therefore \alpha=-2\beta, \beta=\gamma \,\&\, \gamma=\delta$$

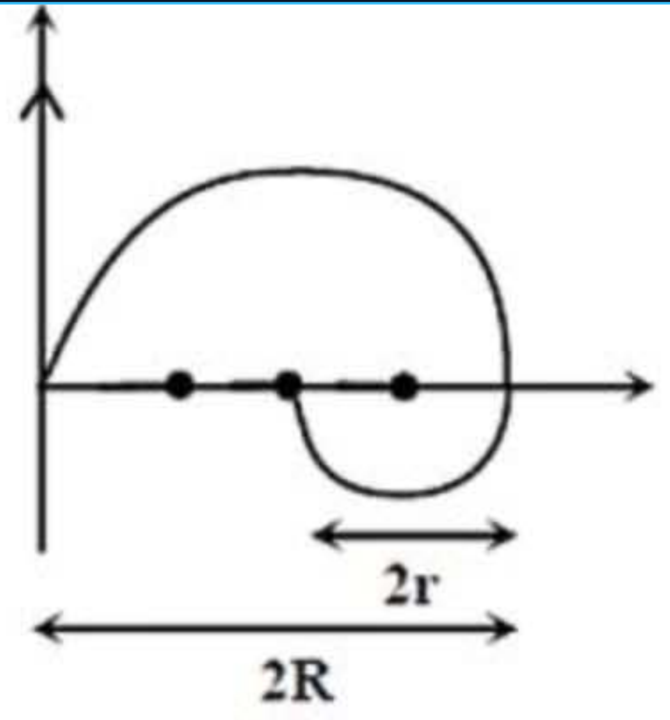
Option (A) satisfies the given condition.

Q. 24 In the xy-plane, the region $y > 0$ has a uniform magnetic field $B_1\hat{k}$ and the region $y < 0$ has another uniform magnetic field $B_2\hat{k}$. A positively charged particle is projected from the origin along the positive Y-axis with speed $v_0 = \pi ms^{-1}$ at $t = 0$, as shown in figure. Neglect gravity in this problem. Let $t = T$ be the time when the particle crosses the X-axis from below for the time when the particle crosses the X-axis from below for the first time. If $B_2 = 4B_1$, the average speed of the particle, in ms^{-1}, along the X-axis in the time interval T is... **(JEE Adv. 2018)**



Ans : (2)

Solution 25



Avg. speed along x-axis

$$= \frac{\text{total distance travelled along x-axis}}{\text{total time taken}}$$

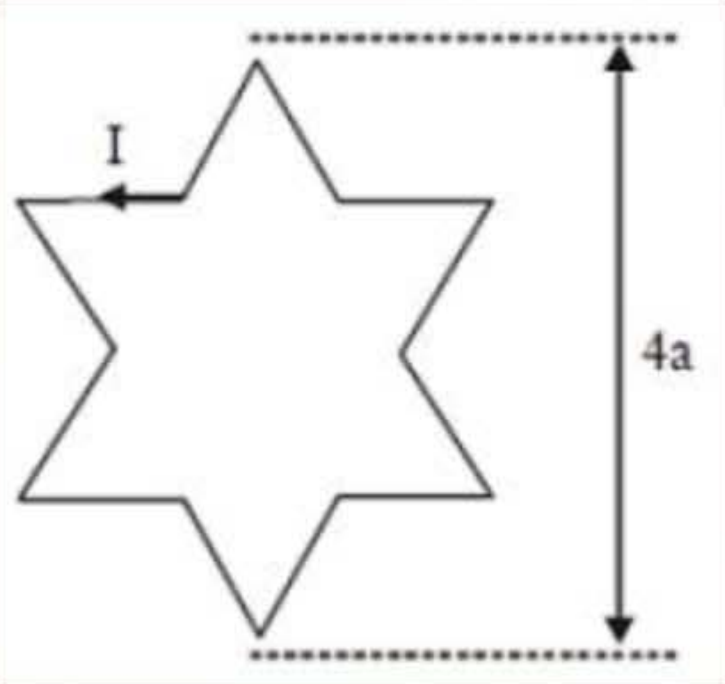
$$= \frac{2R + 2r}{\frac{\pi R}{V_0} + \frac{\pi r}{V_0}} = \frac{2V_0}{\pi} = 2m/s$$

Q. 26 A symmetric star shaped conducting wire loop is carrying a steady state current I as shown in the figure. The distance between the diametrically opposite vertices of the star is 4a. The magnitude of the magnetic field at the center of the loop is

[JEE-Advanced-2017]

(A) $\frac{\mu_0 I}{4\pi a}6[\sqrt{3}-1]$ (B) $\frac{\mu_0 I}{4\pi a}6[\sqrt{3}+1]$

(C) $\frac{\mu_0 I}{4\pi a}3[\sqrt{3}-1]$ (D) $\frac{\mu_0 I}{4\pi a}3[2-\sqrt{3}]$



Ans : (A)

Solution 26

In Δ OAC $\quad \cos 60^\circ = \frac{OC}{OA}$

$$\therefore OC = 2a \times \frac{1}{2} = a$$

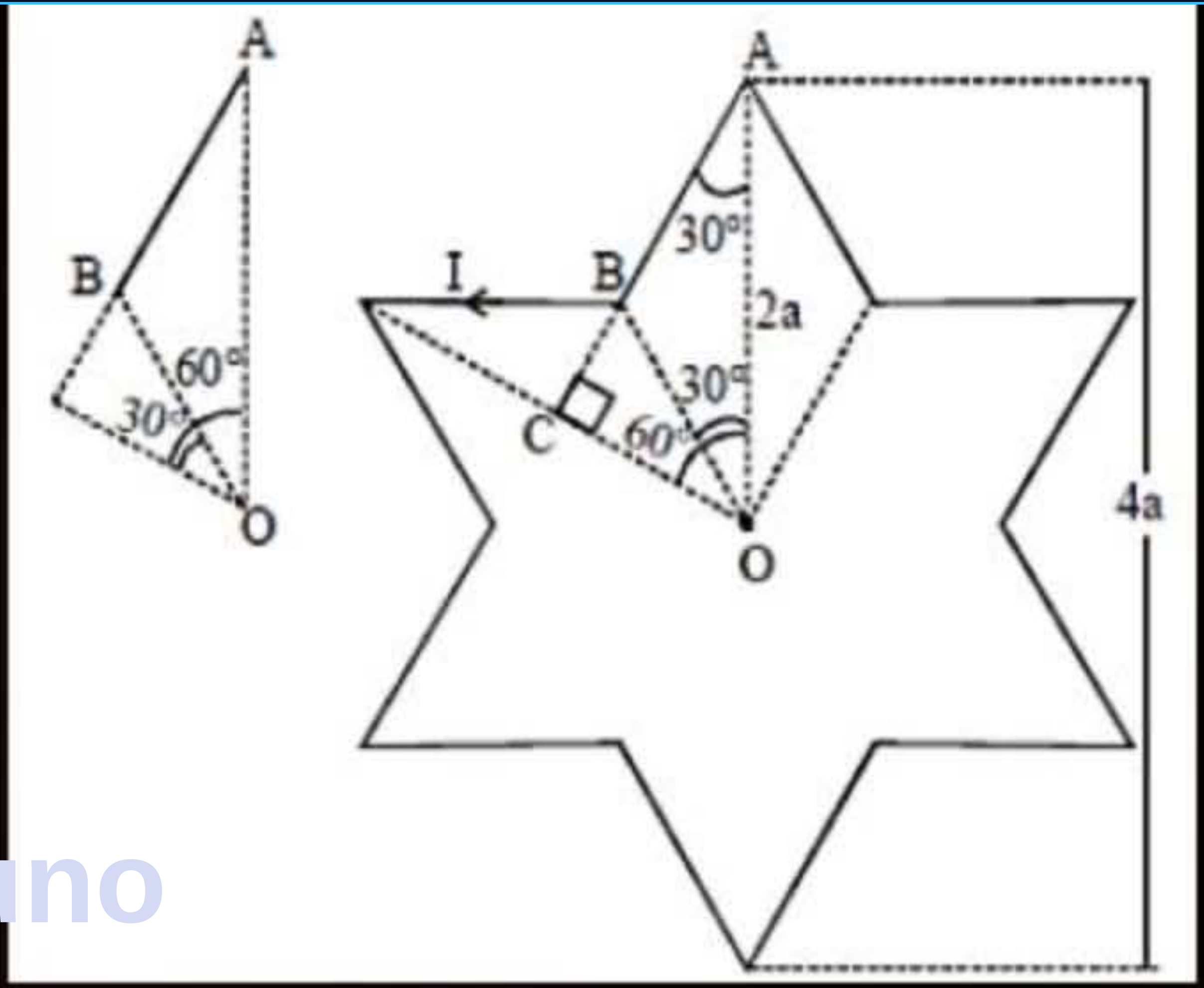
The magnetic field at 'O' due to

$$AB = \frac{\mu_0}{4\pi}\frac{I}{a}[\sin 60^\circ - \sin 30^\circ]$$

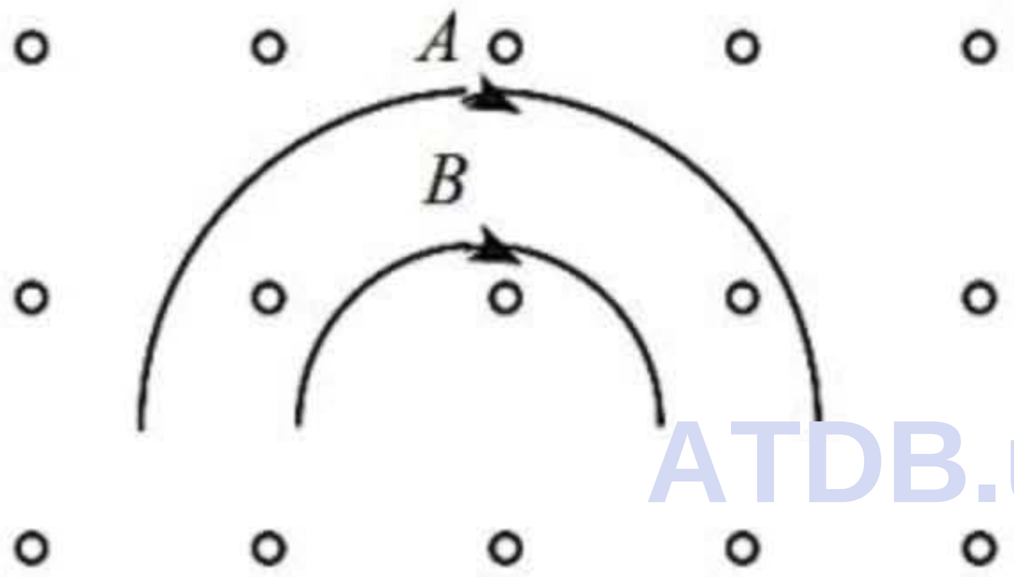
$$= \frac{\mu_0}{4\pi}\frac{I}{a}\left[\frac{\sqrt{3}}{2} - \frac{1}{2}\right] = \frac{\mu_0 I}{4\pi a} \times \frac{1}{2}(\sqrt{3}-1)$$

The total magnetic field due to all the straight segments of the star is

$$= \left[\frac{\mu_0}{4\pi}\frac{I}{a} \times \frac{1}{2}(\sqrt{3}-1)\right] \times 12 = \frac{\mu_0}{4\pi}\frac{I}{a} \times 6(\sqrt{3}-1)$$



Q. 32 Two particles A and B of masses mA and mB respectively and having the same charge are moving in a plane. A uniform magnetic field exists perpendicular to this plane. The speeds of the particles are vA and vB, respectively and the trajectories are as shown in the figure. Then **(IIT-JEE 2001)**



(a) $m_A v_A < m_B v_B$ (b) $m_A v_A > m_B v_B$

(c) $m_A < m_B$ and $v_A < v_B$ (d) $m_A = m_B$ and $v_A = v_B$

Ans : (b)

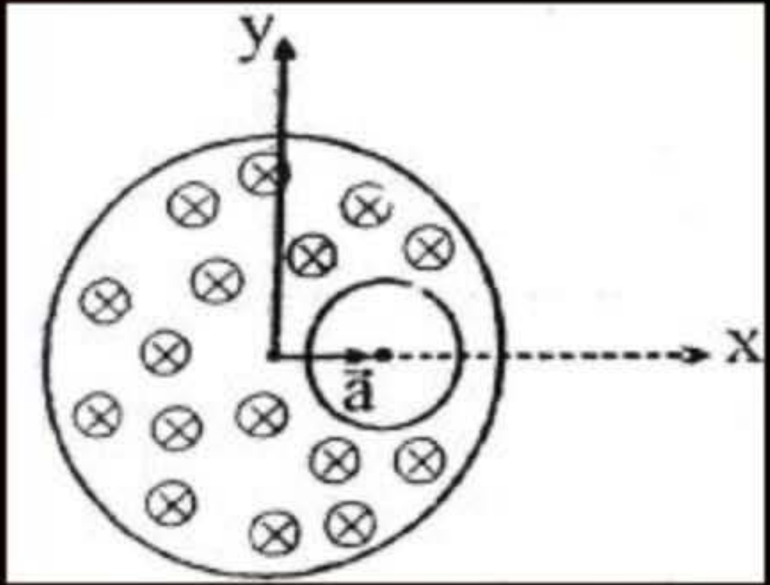
Q. 39 Figure shows crosssection view of a infinite cylindrical wire with a cavity, current density is uniform $\vec{j} = -j_0\hat{k}$ as shown in figure

A. magnetic field inside cavity is uniform

B. magnetic field inside cavity is along $\vec{a}$

C. magnetic field inside cavity is perpendicular to $\vec{a}$

D. If an electron is projected with velocity $v_0\hat{j}$ inside the cavity it will move undeviated.



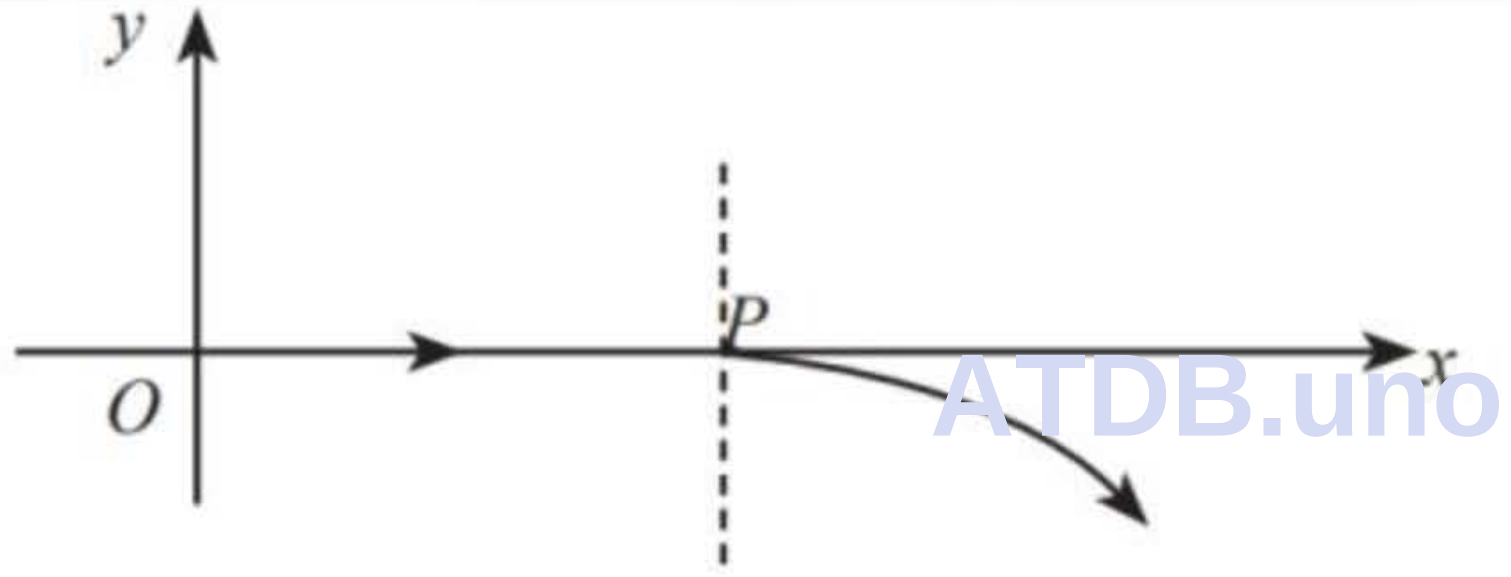
Ans : (A, C, D)

Solution 39

Correct Answer - A::C::D

Magnetic field is given by $\vec{B} = \frac{\mu_0 \left(\vec{j} \times \vec{a}\right)}{2}$

Q. 49 For a positively charged particle moving in a $x-y$ plane initially along the x-axis, there is a sudden change in its path due to the presence of electric and/or magnetic fields beyond P. The curved path is shown in the $x-y$ plane and is found to be non-circular) Which one of the following combinations is possible? **(IIT-JEE 2003)**



(a) $E = 0; B = b\hat{j} + c\hat{k}$ (b) $E = a\hat{i}; B = c\hat{k} + a\hat{i}$

(c) $E = 0; B = c\hat{j} + b\hat{k}$ (d) $E = a\hat{i}; B = c\hat{k} + b\hat{j}$

Ans : (b)

Solution 49

Electric field can deviate the path of the particle in the shown direction only when it is along negative y-direction. In the given options vector E is either zero or along x-direction. Hence, it is the magnetic field which is really responsible for its curved path. Options (a) and (c) cannot be accepted as the path will be circular in that case. Option (d) is wrong because in that case component of net force on the particle also

comes in $\hat{k}$ direction which is not acceptable as the particle is moving in x-y plane. Only in option (b) the particle can move in x-y plane.

In option (d) $\vec{F}_{net} = q\vec{E} + q(\vec{v} \times \vec{B})$

Initial velocity is along x-direction. So, let

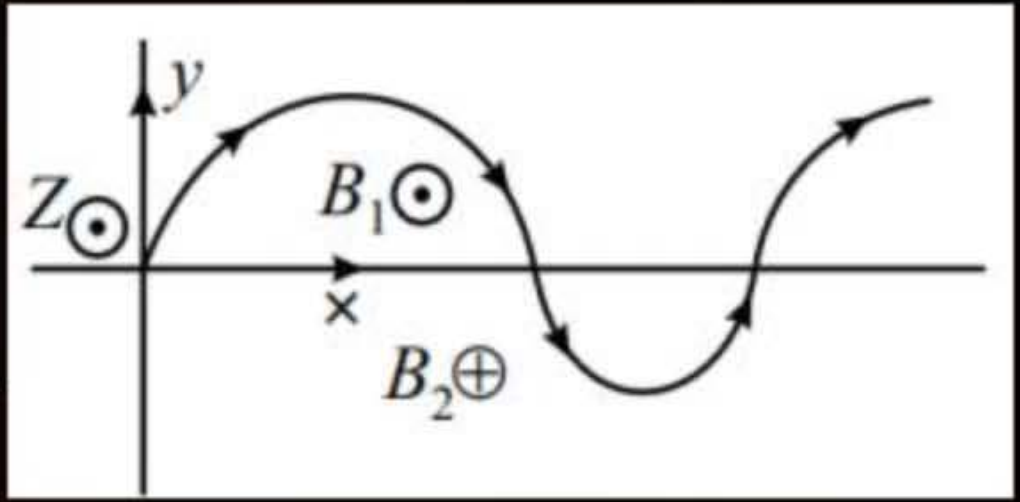
$$\vec{v} = v\hat{i}$$

$$\vec{F}_{net} = qa\hat{i} + q[(v\hat{i}) \times (c\hat{k} + b\hat{j})]$$

$$= qa\hat{i} - qvc\hat{j} + qvb\hat{k}$$

In option (b) $\vec{F}_{net} = q(a\hat{i}) + q[(v\hat{i}) \times (c\hat{k} + a\hat{i})] = qa\hat{i} - qvc\hat{j}$

Q. 64 At $t = 0$ a charge q is at the origin and moving in the y-direction with velocity $\vec{v} = v\hat{j}$. The charge moves in a magnetic field that is for $y > 0$ out of page and given by $B_1\hat{z}$ and for $y < 0$ into the page and given $-B_2\hat{z}$. The charge's subsequent trajectory is shown in the sketch. From this information, we can deduce that



(a) $q > 0$ and $|B_1| < |B_2|$

(b) $q < 0$ and $|B_1| < |B_2|$

(c) $q > 0$ and $|B_1| > |B_2|$

(d) $q < 0$ and $|B_1| > |B_2|$

Ans : (a)

Solution 64

$$\vec{F} = q\left(\vec{V} \times \vec{B}\right)$$

$$B = B_1\hat{k}$$

$$V = V\hat{j}$$

Force at origin is along x axis.

$\hat{j} \times \hat{k} = \hat{i}$ so q should be positive.

$$r = \frac{mV}{qB}$$

$$\because r_2 < r_1$$

$$\therefore |B_2| > |B_1|$$

Q. 67 A current I flows along a thin wire shaped as a regular polygon with n sides which can be inscribed into a circle of radius R. Find the magnetic induction at the centre of the polygon. Analyse the obtained expression at $n \to \infty$.

Ans. $B = n \propto_0 I \ \tan(\pi n)/2\pi R$, for $n \to \infty$ $B = \propto_0 I/2R$

Solution 67

As $\angle AOB = \frac{2\pi}{n}$, OC or perpendicular distance of any segment from centre equals Rcos π/n. Now magnetic induction at O, due to die right current carrying element AB

$$= \frac{\mu_0}{4\pi}\frac{i}{R\cos\frac{\pi}{n}}2\sin\frac{\pi}{n}$$

(From Biot- Savart's law, the magnetic field at O due to any section such as AB is perpendicular to the plane of the figure and has the magnitude.)

$$B = \int \frac{\mu_0}{4\pi} i \frac{dx}{r^2}\cos\theta$$

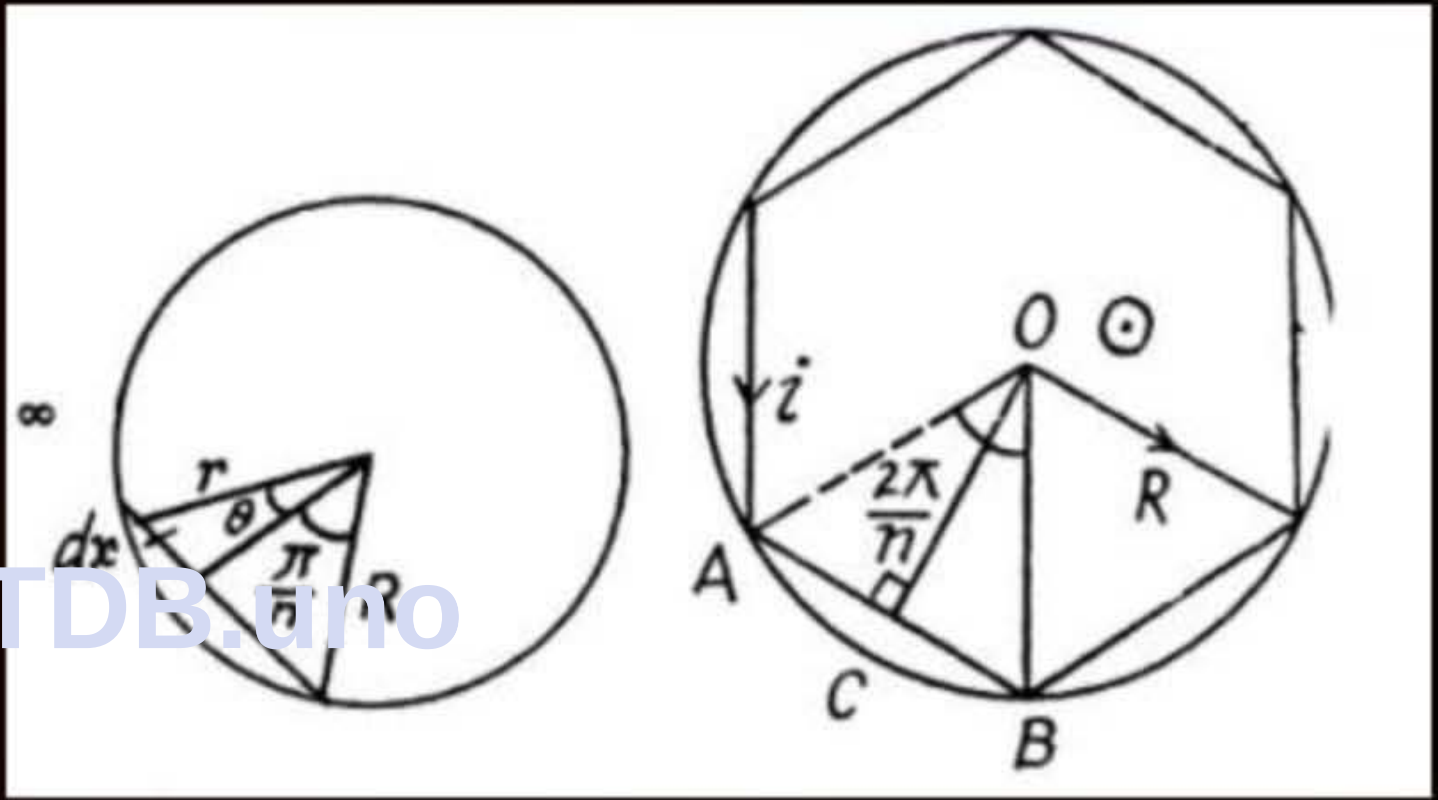
$$= \int_{-\frac{\pi}{n}}^{\frac{\pi}{n}} \frac{\mu_0 i}{4\pi} \frac{R\cos\frac{\pi}{n}\sec^2\theta d\theta}{R^2\cos\frac{2\pi}{n}\sec^2\theta}\cos\theta \qquad = \frac{\mu_0 i}{4\pi}\frac{1}{R\cos\frac{\pi}{n}}\,2\sin\frac{\pi}{n}$$

As there are n number of sides and magnetic induction vectors, due to each side at O, are equal in magnitude and direction. So,

$$B_0 = \frac{\mu_0}{4\pi}\frac{ni}{R\cos\frac{\pi}{n}}2\sin\frac{\pi}{n}\cdot n$$

$$= \frac{\mu_0}{2\pi}\frac{ni}{R}\tan\frac{\pi}{n} \quad \text{and for } n \to \infty$$

$$B_0 = \frac{\mu_0}{2}\frac{i}{R}\lim_{n\to\infty}\left(\frac{\tan\frac{\pi}{n}}{\pi/n}\right) = \frac{\mu_0}{2}\frac{i}{R}$$



Q. 68 Find the magnetic induction at the centre of a rectangular wire frame whose diagonal is equal to $d = 16$ cm and the angle between the diagonals is equal to $\phi = 30Ÿ$; the current flowing in the frame equals $I = 5.0$ A.

Ans. $B = 4\propto_0 I/\pi d \sin\phi = 0.10$ mT.

Q. 69 A current $I = 5.0$ A flows along a thin wire shaped as shown in Fig. 3.59. The radius of a curved part of the wire is equal to $R = 120$ mm, the angle $2\phi = 90$Y. Find the magnetic induction of the field at the point O.

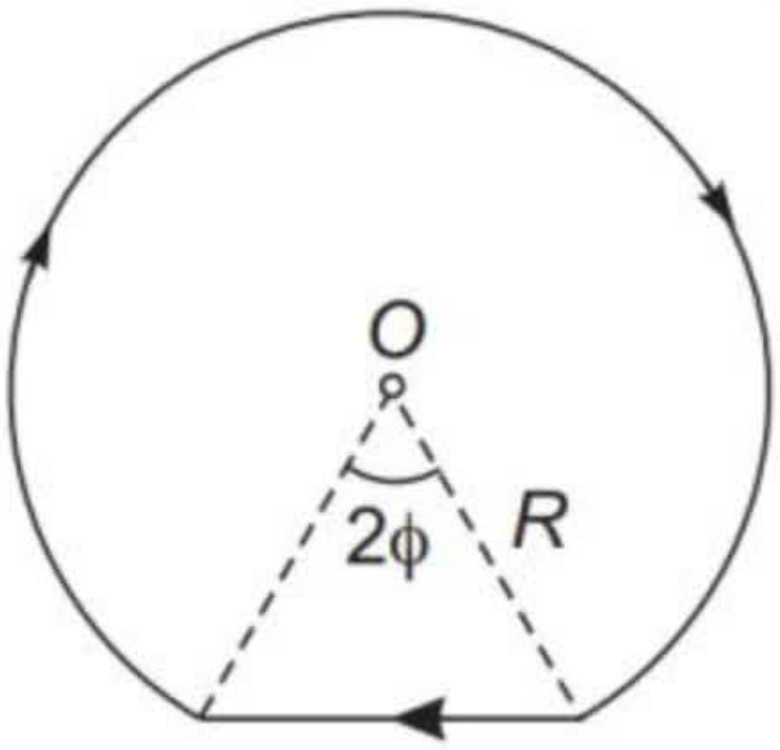


Fig. 3.59

Ans. $B = (\pi - \phi + \tan\phi) \propto_0 I/2\pi R = 28 \propto$T.

Solution 69

Magnetic induction due to the arc segment at O,

$$B_{arc} = \frac{\mu_0 i}{4\pi R}(2\pi - 2\varphi)$$

and magnetic induction due to the line segment at O,

$$B_{line} = \frac{\mu_0 i}{4\pi R\cos\varphi}[2\sin\varphi]$$

So, total magnetic induction at O,

$$B_o = B_{arc} + B_{line} = \frac{\mu_0 i}{2\pi R}[\pi - \varphi + \tan\varphi] = 28\ \mu T$$

Q. 70 Find the magnetic induction of the field at the point O of a loop with current I, whose shape is illustrated.

(a) In Fig. 3.60a, the radii a and b, as well as the angle ϕ are known;

(b) in Fig. 3.60b, the radius a and the side b are known.

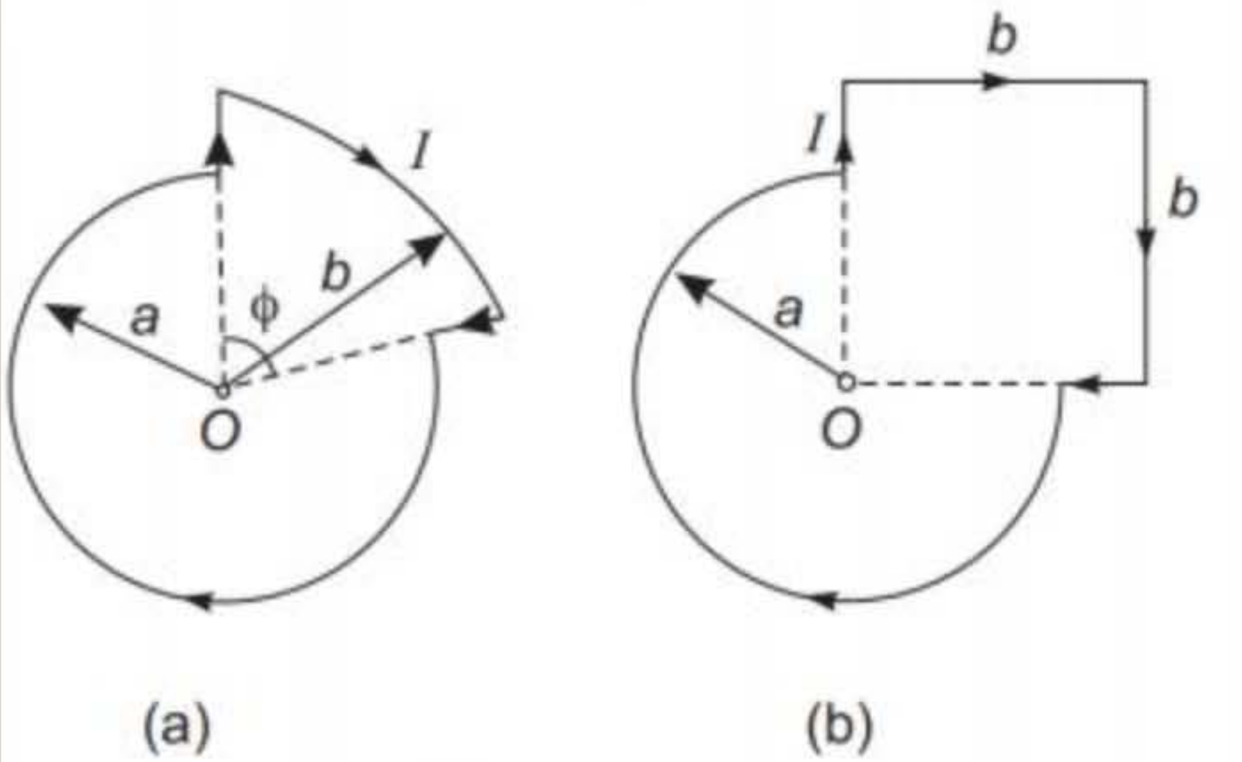


Fig. 3.60

Ans. (a) $B = \frac{\propto_0 I}{4\pi}\left(\frac{2\pi - \phi}{a} + \frac{\phi}{b}\right)$; (b) $B = \frac{\propto_0 I}{4\pi}\left(\frac{3\pi}{4a} + \frac{\sqrt{2}}{b}\right)$.

Solution 70

(a) From the Biot-Savart law,

$$dB = \frac{\mu_0}{4\pi} i \frac{(\vec{dl} \times \vec{r})}{r^3}$$

So, magnetic field induction due to the segment 1 at O,

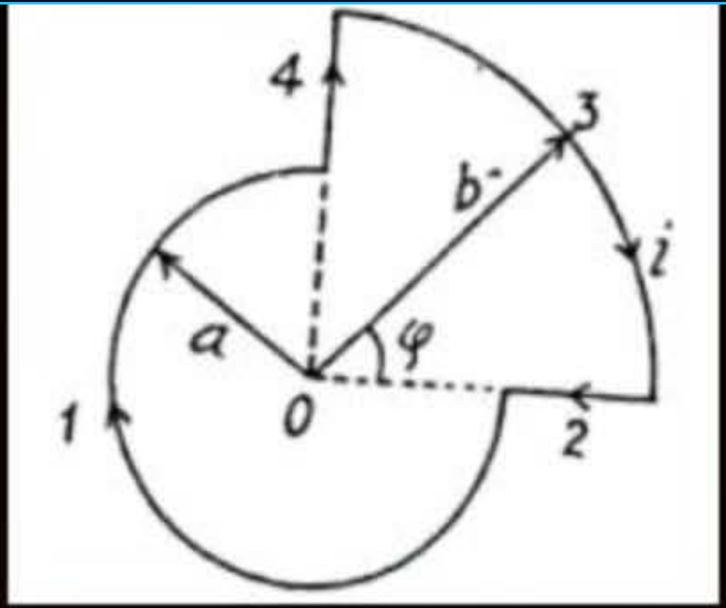
$$B_1 = \frac{\mu_0}{4\pi}\frac{i}{a}(2\pi - \varphi)$$

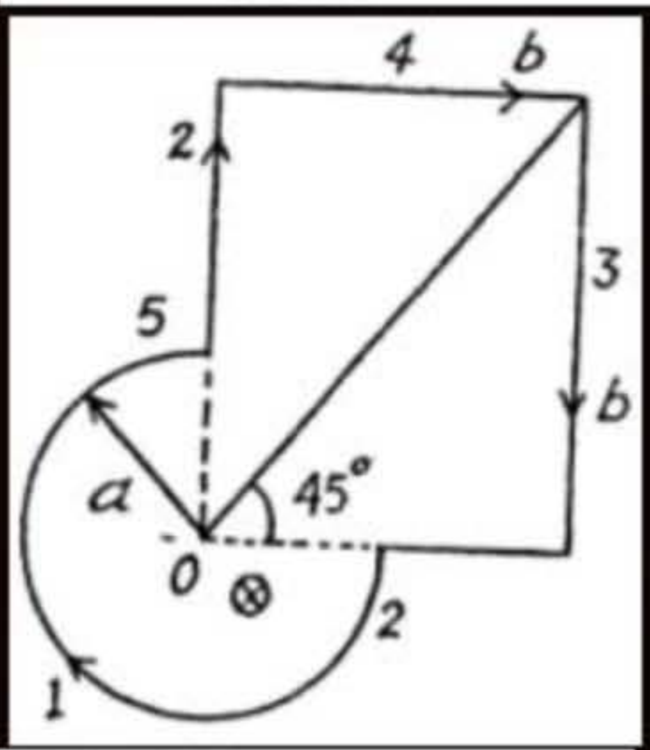
also $B_2 = B_4 = 0$, as $\vec{dl} \uparrow\uparrow \vec{r}$

and $B_3 = \frac{\mu_0}{4\pi}\frac{i}{b}\varphi$

Hence, $B_0 = B_1 + B_2 + B_3 + B_4$

$$= \frac{\mu_0}{4\pi} i \left[\frac{2\pi - \varphi}{a} + \frac{\varphi}{b}\right],$$





(b) Here, $B_1 = \frac{\mu_0}{4\pi}\frac{i}{a}\frac{3\pi}{a}$, $\vec{B_2} = 0$,

$$B_3 = \frac{\mu_0}{4\pi}\frac{i}{b}\sin 45°,$$

$$B_4 = \frac{\mu_0}{4\pi}\frac{i}{b}\sin 45°,$$

and $B_5 = 0$

So, $B_0 = B_1 + B_2 + B_3 + B_4 + B_5$

$$= \frac{\mu_0}{4\pi}\frac{i}{a}\frac{3\pi}{2} + 0 + \frac{\mu_0}{4\pi}\frac{i}{b}\sin 45° + \frac{\mu_0}{4\pi}\frac{i}{b}\sin 45° + 0$$

$$= \frac{\mu_0}{4\pi} i \left[\frac{3\pi}{2a} + \frac{\sqrt{2}}{b}\right]$$

Q. 71 A current I flows in a long straight wire with cross-section having the form of a thin half-ring of radius R (Fig. 3.61). Find the induction of the magnetic field at the point O.

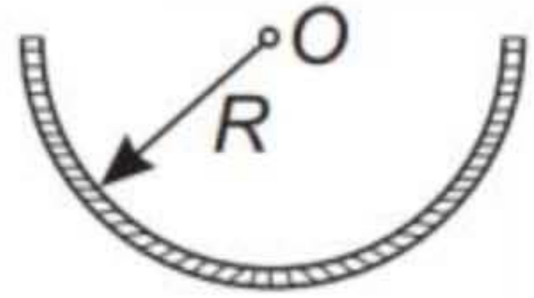


Fig. 3.61

Ans. $B = \propto_0 I / \pi^2 R.$

Solution 71

First of all let us find out the direction of vector $\vec{B}$ at point O. For this purpose, we divide the entire conductor into elementary fragments with current di. It is obvious that the sum of any two symmetric fragments gives a resultant along $\vec{B}$ shown in the figure below and consequently, vector $\vec{B}$ will also be directed as shown

So, $|\vec{B}| = \int dB \sin\varphi$ (1)

$$= \int \frac{\mu_0}{2\pi R} di \sin\varphi$$

$$= \int_0^{\pi} \frac{\mu_0}{2\pi^2 R} i \sin\varphi d\varphi, \text{ (as } di = \frac{i}{\pi} d\varphi)$$

Hence $B = \frac{\mu_0 i}{\pi^2 R}$

Q. 72 Find the magnetic induction of the field at the point O if a current-carrying wire has the shape shown in Fig. 3.62a, b, c. The radius of the curved part of the wire is R, the linear parts are assumed to be very long.

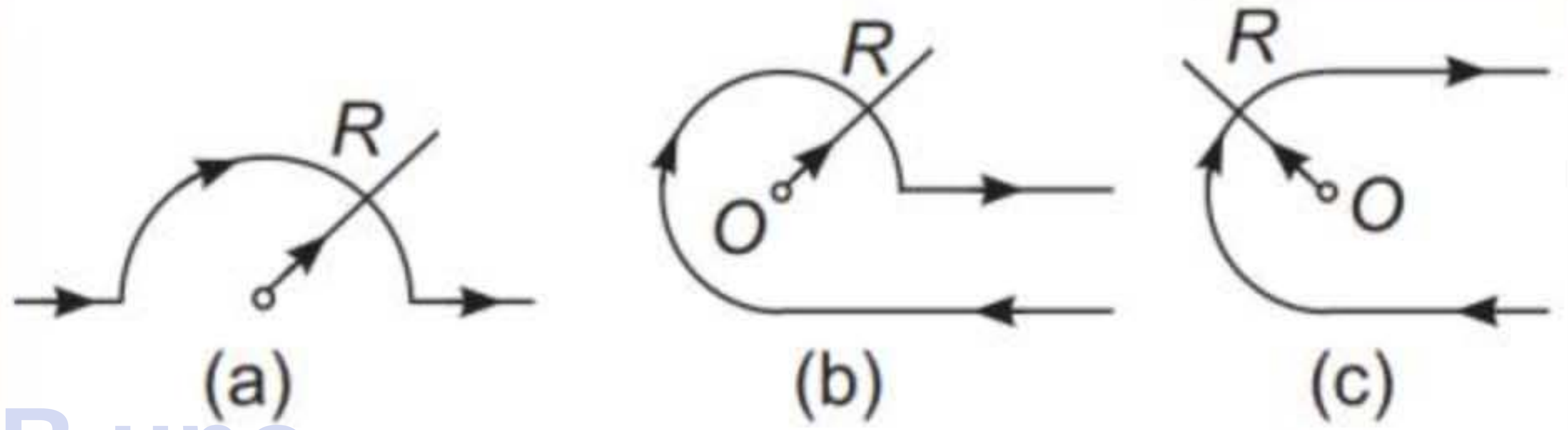
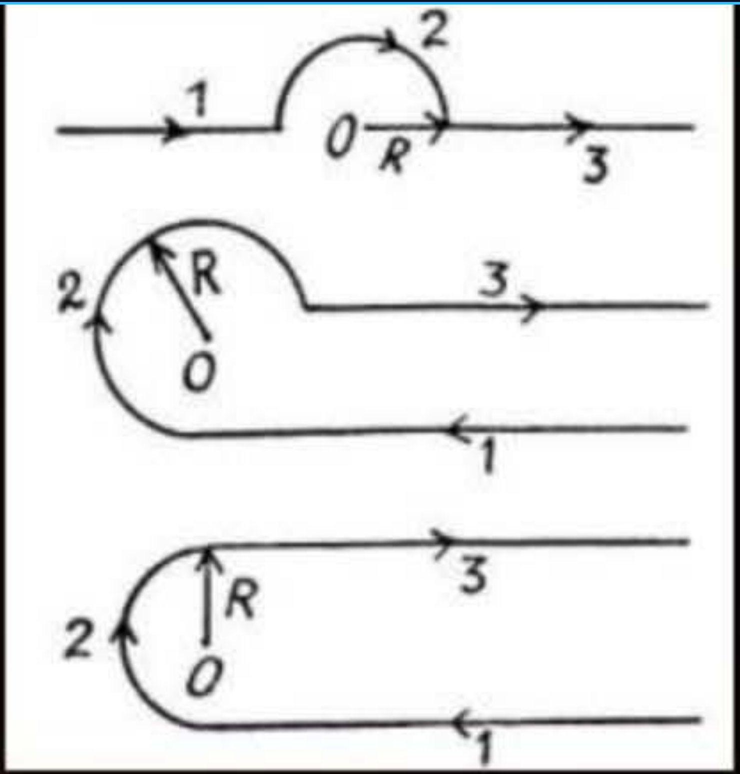


Fig. 3.62

Ans. (a) $B = (\propto_0/4\pi)(\pi I/R)$; (b) $B = (\propto_0/4\pi)(1 + 3\pi/2)\, I/R$;

Solution 72



(a) From symmetry

$$B_0 = B_1 + B_2 + B_3$$

$$= 0 + \frac{\mu_0}{4\pi}\frac{i}{R}\pi + 0 = \frac{\mu_0}{4}\frac{i}{R}$$

(b) From symmetry

$$B_0 = B_1 + B_2 + B_3$$

$$= \frac{\mu_0}{4\pi}\frac{i}{R} + \frac{\mu_0}{2\pi}\frac{i}{R}\frac{3\pi}{2} + 0 = \frac{\mu_0}{4\pi}\frac{i}{R}\left[1 + \frac{3\pi}{2}\right]$$

(c) From symmetry

$$B_0 = B_1 + B_2 + B_3$$

$$= \frac{\mu_0}{4\pi}\frac{i}{R} + \frac{\mu_0}{4\pi}\frac{i}{R}\pi + \frac{\mu_0}{4\pi}\frac{i}{R} = \frac{\mu_0}{4\pi}\frac{i}{R}(2 + \pi).$$

Q. 74 Find the magnetic induction at the point O if the wire carrying a current $I = 8.0$ A has the shape shown in Fig. 3.63a, b, c.
The radius of the curved part of the wire is $R = 100$ mm, the linear parts of the wire are very long

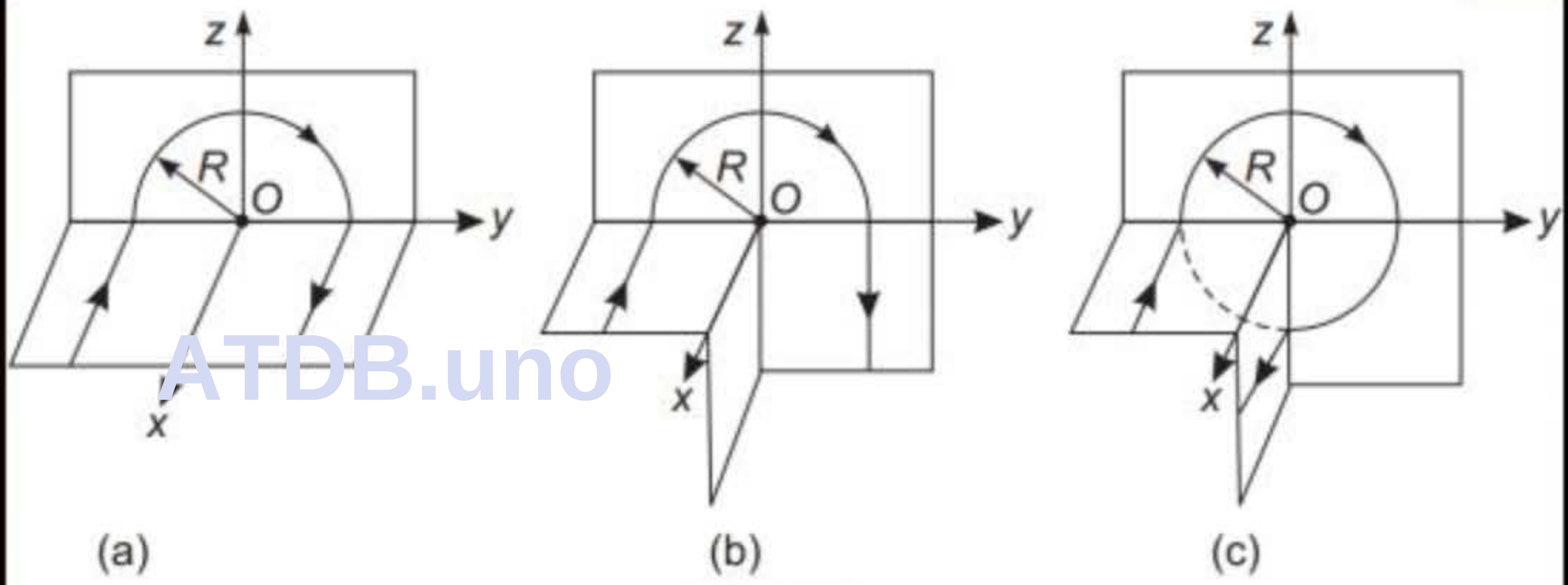


Fig. 3.63

Ans.

(a) $B = (\propto_0/4\pi)\sqrt{4 + \pi^2}\ I/R = 0.30 \propto\text{T};$

(b) $B = (\propto_0/4\pi) \times \sqrt{2 + 2\pi + \pi^2}\, I/R = 0.34 \propto\text{T};$

(c)

Solution 74

(a) $\vec{B}_0 = \vec{B}_1 + \vec{B}_2 + \vec{B}_3$

$$= \frac{\mu_0}{4\pi}\frac{i}{R}(-\vec{k}) + \frac{\mu_0}{4\pi}\frac{i}{R}\pi(-\vec{i}) + \frac{\mu_0}{4\pi}\frac{i}{R}(-\vec{k})$$

$$= -\frac{\mu_0}{4\pi}\frac{i}{R}[2\vec{k} + \pi\vec{i}]$$

So, $|\vec{B}_0| = \frac{\mu_0}{4\pi}\frac{i}{R}\sqrt{\pi^2 + 4} = 0{\cdot}30\ \mu T$

(b) $\vec{B}_0 = \vec{B}_1 + \vec{B}_2 + \vec{B}_3$

$$= \frac{\mu_0}{4\pi}\frac{i}{R}(-\vec{k}) + \frac{\mu_0}{4\pi}\frac{i}{R}\pi(-\vec{i}) + \frac{\mu_0}{4\pi}\frac{i}{R}(-\vec{i})$$

$$= -\frac{\mu_0}{4\pi}\frac{i}{R}[\vec{k} + (\pi + 1)\vec{i}]$$

So,

$$|\vec{B}_0| = \frac{\mu_0}{4\pi}\frac{i}{R}\sqrt{1 + (\pi + 1)^2} = 0{\cdot}34\ \mu T$$

(c) Here using the law of parallel resistances

$i_1 + i_2 = i$ and $\frac{i_1}{i_2} = \frac{1}{3}$,

So, $\frac{i_1 + i_2}{i_2} = \frac{4}{3}$

Hence $i_2 = \frac{3}{4}i$, and $i_1 = \frac{1}{4}i$

Thus $\vec{B}_0 = \frac{\mu_0}{4\pi}\frac{i}{R}(-\vec{k}) + \frac{\mu_0}{4\pi}\frac{i}{R}(-\vec{j})$

$$+ \left[\frac{\mu_0}{4\pi}\left(\frac{3\pi}{2}\right)\frac{i_1}{R}(-\vec{i}) + \frac{\mu_0}{4\pi}\frac{(\pi/2)\,i_2}{R}\vec{i}\right]$$

$$= \frac{-\mu_0}{4\pi}\frac{i}{R}(\vec{j} + \vec{k}) + 0$$

Thus, $|\vec{B}_0| = \frac{\mu_0}{4\pi}\frac{\sqrt{2}\,i}{R} = 0{\cdot}11\ \mu T$

Q. 81 A thin insulated wire forms a plane spiral of $N = 100$ tight turns carrying a current $I = 8$ mA. The radii of inside and outside turns (Fig. 3.67) are equal to $a = 50$ mm and $5 = 100$ mm. Find:

(a) the magnetic induction at the centre of the spiral;

(b) the magnetic moment of the spiral with a given current.

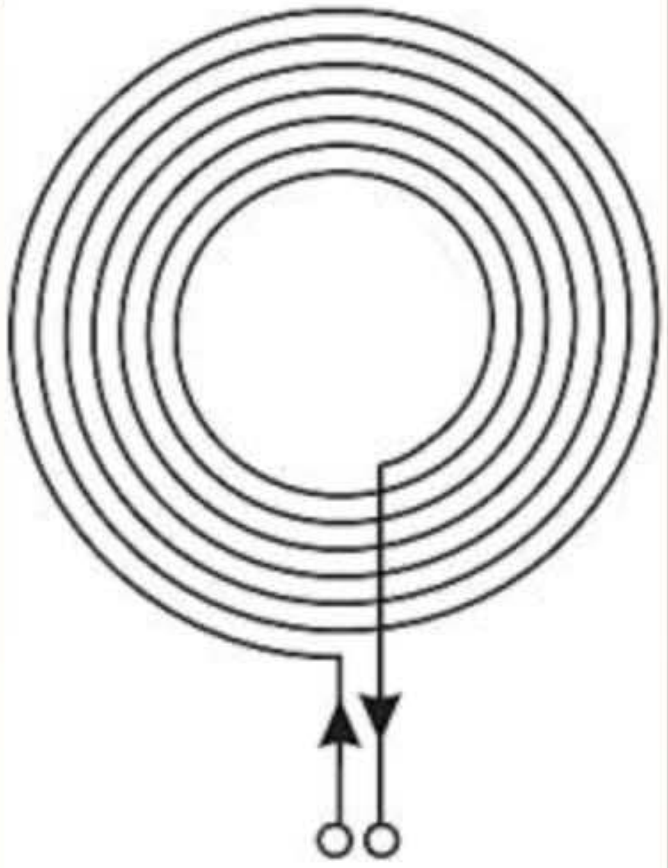


Fig. 3.67

Ans. (a) $B = \frac{\propto_0 IN \ln(b/a)}{2(b-a)} = 7 \propto\text{T}$; (b) $p_m = 1/3\ \pi IN(a^2 + ab + b^2) = 15\ \text{mA} \cdot \text{m}^2$.

Solution 81

(a) From Biot-Savart's law, the magnetic induction due to a circular current carrying wire loop at its centre is given by,

$$B_r = \frac{\mu_0}{2r} i$$

The plane spiral is made up of concentric circular loops, having different radii, varying from a to b. Therefore, the total magnetic induction at the centre,

$$B_0 = \int \frac{\mu_0}{2r} dN \qquad (1)$$

where $\frac{\mu_0}{2r} i$ is the contribution of one turn of radius r and dN is the number of turns in the interval (r, r + dr)

i.e. $dN = \frac{N}{b-a} dr$

Substituting in equation (1) and integrating the result over r between a and b, we obtain,

$$B_0 = \int_a^b \frac{\mu_0 i}{2r} \frac{N}{(b-a)} dr = \frac{\mu_0 i N}{2(b-a)} \ln \frac{b}{a}$$

(b) The magnetic moment of a turn of radius r is $p_m = i\pi r^2$ and of all turns,

$$p = \int p_m \, dN = \int_a^b i\pi r^2 \frac{N}{b-a} dr$$

$$= \frac{\pi i N (b^3 - a^2)}{3(b-a)}$$

Q. 94 Two particles, each having a mass m are placed at a separation d in a uniform magnetic field B as shown in figure (34-E19). They have opposite charges of equal magnitude q. At time $t = 0$, the particles are projected towards each other, each with a speed v. Suppose the Coulomb force between the charges is switched off. (a) Find the maximum value v_m of the projection speed so that the two particles do not collide. (b) What would be the minimum and maximum separation between the particles if $v = v_m/2$? (c) At what instant will a collision occur between the particles if $v = 2v_m$? (d) Suppose $v = 2v_m$ and the collision between the particles is completely inelastic. Describe the motion after the collision.

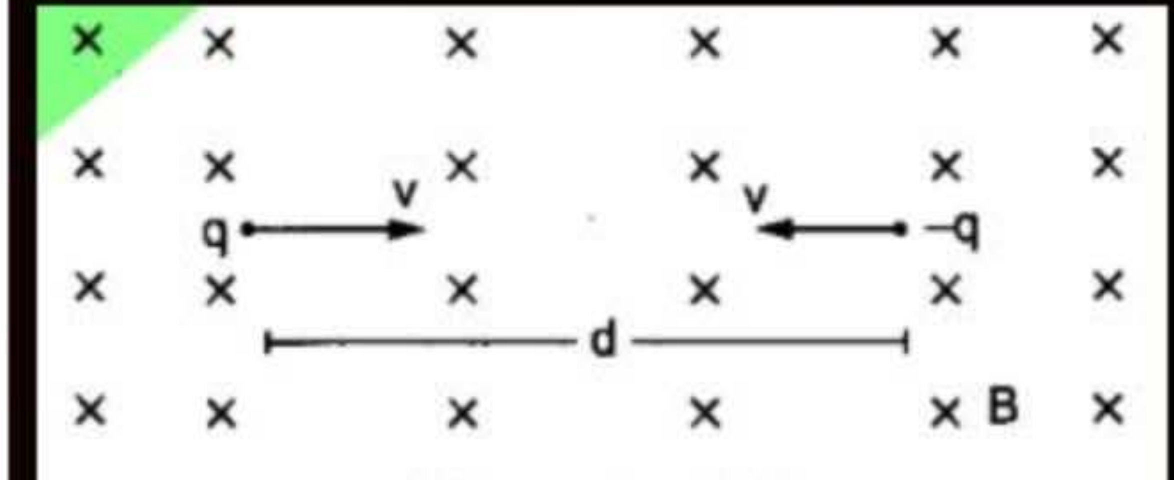


Figure 34-E19

Ans. (a) $\frac{qBd}{2\text{ m}}$ (b) $\frac{d}{2}, \frac{3\,d}{2}$ (c) $\frac{\pi m}{6\,qB}$ (d) the particles stick together and the combined mass moves with constant speed v_m along the straight line drawn upward in the plane of figure through

Solution 94

(a) The particulars will not collide if

$d = r_1 + r_2$

$\Rightarrow d = \frac{mV_m}{qB} + \frac{mV_m}{qB}$

$\Rightarrow d = \frac{2mV_m}{qB} \Rightarrow V_m = \frac{qBd}{2m}$

(b) $V = \frac{V_m}{2}$

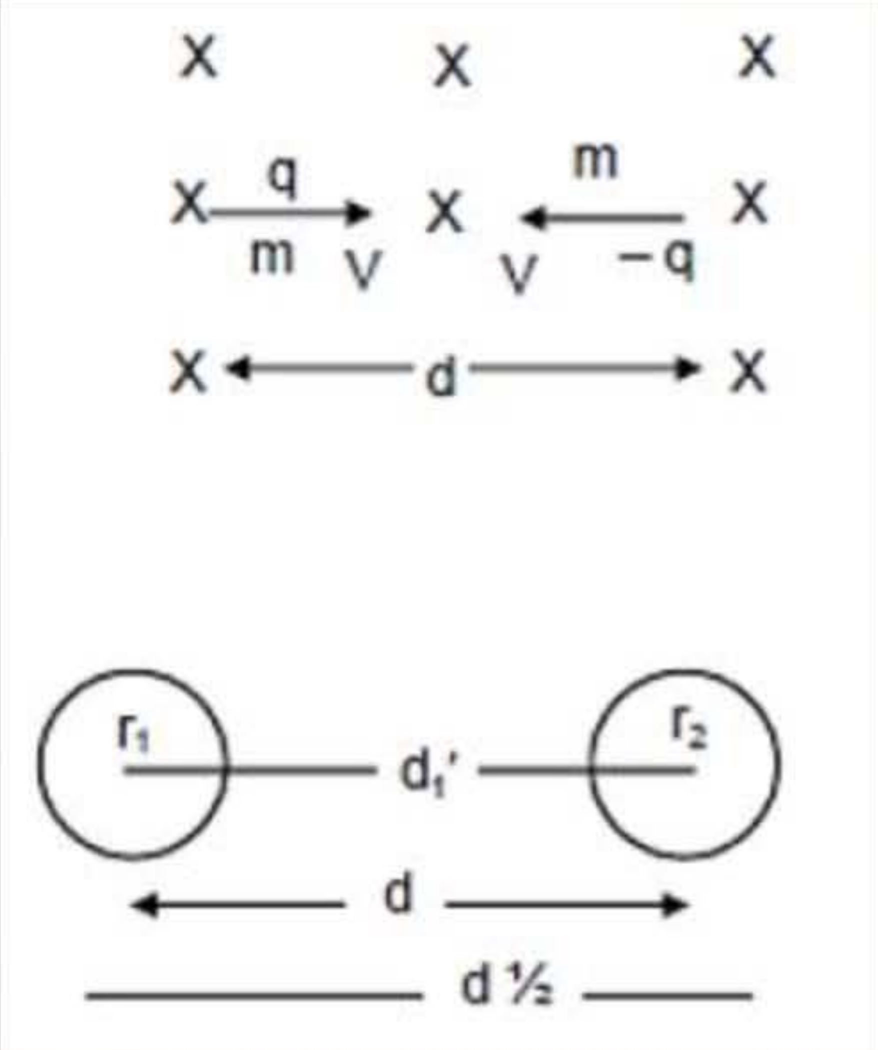
$d_1' = r_1 + r_2 = 2\left(\frac{m \times qBd}{2 \times 2m \times qB}\right) = \frac{d}{2}$ (min. dist.)

Max. distance $d_2' = d + 2r = d + \frac{d}{2} = \frac{3d}{2}$

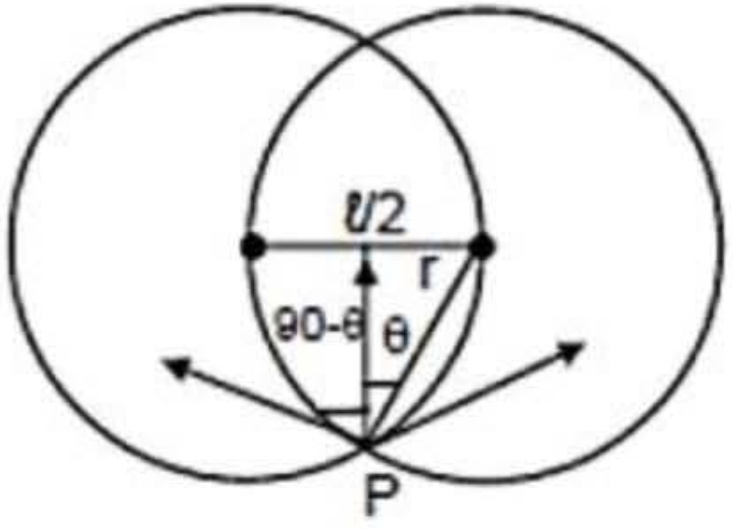
(c) $V = 2V_m$

$r_1' = \frac{m_2 V_m}{qB} = \frac{m \times 2 \times qBd}{2n \times qB}$, $r_2 = d$ $\therefore$ The arc is 1/6

(d) $V_m = \frac{qBd}{2m}$



The particles will collide at point P. At point p, both the particles will have motion m in upward direction. Since the particles collide inelastically the stick together.



Distance l between centres = d, $\sin\theta = \frac{l}{2r}$

Velocity upward = $v\cos 90-\theta = V\sin\theta = \frac{Vl}{2r}$

$$\frac{mv^2}{r} = qvB \Rightarrow r = \frac{mv}{qB}$$

$$V\sin\theta = \frac{vl}{2r} = \frac{vl}{2\frac{mv}{qb}} = \frac{qBd}{2m} = V_m$$

Hence the combined mass will move with velocity V_m

QUESTION

A particle of charge q and mass m is moving with a velocity $-v\hat{i}(v \neq 0)$ towards a large screen placed in the Y-Z plane at a distance d. If there is a magnetic field $\vec{B} = B_0\hat{k}$, the minimum value of v for which the particle will not hit the screen is:

[JEE Main-2020]

1. $\frac{qdB_0}{2m}$
2. $\frac{qdB_0}{m}$
3. $\frac{2qdB_0}{m}$
4. $\frac{qdB_0}{3m}$

Ans : (2)

QUESTION

A proton, a deuteron and an α particle are moving with same momentum in a uniform magnetic field. The ratio of magnetic forces acting on them is _______ and their speed is ______ in the ratio. [JEE Main-2021]

1. 1 : 2 : 4 and 2 : 1 : 1
2. 2 : 1 : 1 and 4 : 2 : 1
3. 4 : 2 : 1 and 2 : 1 : 1
4. 1 : 2 : 4 and 1 : 1 : 2

Ans : (2)

QUESTION

Magnetic fields at two points on the axis of a circular coil at a distance of 0.05 m and 0.2 m from the centre are in the ratio 8 : 1. The radius of coil is ______.

[JEE Main-2021]

(1) 0.2 m

(2) 0.1 m

(3) 0.15 m

(4) 1.0 m

Ans : (2)

QUESTION

A charge Q is moving $\overrightarrow{dl}$ distance in the magnetic field $\vec{B}$. Find the value of work done by $\vec{B}$.

[JEE Main-2021]

(1) 1

(2) infinite

(3) zero

(4) –1

Ans : (3)

QUESTION

A deuteron and an alpha particle having equal kinetic energy enter perpendicular into a magnetic field. Let r_d and r_α be their respective radii of circular path. The value of r_d/r_α is equal to: **[JEE Main-2021]**

(1) $1/\sqrt{2}$

(2) $\sqrt{2}$

(3) 1

(4) 2

Ans : (2)

QUESTION

Two ions having same mass have charges in the ratio 1 : 2. They are projected normally in a uniform magnetic field with their speeds in the ratio 2 : 3. The ratio of the radii of their circular trajectories is: [JEE Main-2021]

(1) 1 : 4

(2) 4 : 3

(3) 3 : 1

(4) 2 : 3

Ans : (2)

QUESTION

Two ions of masses 4 amu and 16 amu have charges +2e and +3e respectively. These ions pass through the region of constant perpendicular magnetic field. The kinetic energy of both ions is same. Then: [JEE Main-2021]

1. lighter ion will be deflected less than heavier ion

2. lighter ion will be deflected more than heavier ion
3. both ions will be deflected equally
4. no ion will be deflected.

Ans : (2)

QUESTION

A coil having N turns is wound tightly in the form of a spiral with inner and outer radii 'a' and 'b' respectively. Find the magnetic field at centre, when a current I passes through coil: **[JEE Main-2021]**

(1) $\frac{\mu_0 IN}{2(b-a)}\log_e\left(\frac{b}{a}\right)$

(2) $\frac{\mu_0 I}{8}\log_e\left[\frac{a+b}{a-b}\right]$

(3) $\frac{\mu_0 I}{4(a-b)}\left[\frac{1}{b}-\frac{1}{b}\right]$

(4) $\frac{\mu_0 I}{8}\left(\frac{a-b}{a+b}\right)$

Ans : (1)

QUESTION

Two charged particles, having same kinetic energy, are allowed to pass through a uniform magnetic field perpendicular to the direction of motion. If the ratio of radii of their circular paths is 6 : 5 and their respective masses ratio is 9 : 4. Then, the ratio of their charges will be: [JEE Main-2022]

(1) 8 : 5

(2) 5 : 4

(3) 5 : 3

(4) 8 : 7

Ans : (2)

QUESTION

A charge particle is moving in a uniform magnetic field $(2\hat{i} + 3\hat{j})T$. If it has an acceleration of $(\alpha\hat{i} - 4\hat{j})\,\text{m/s}^2$, then the value of α will be: [JEE Main-2022]

(1) 3

(2) 6

(3) 12

(4) 2

Ans : (2)

QUESTION

The magnetic field at the center of current carrying circular loop is B_1. The magnetic field at a distance of $\sqrt{3}$ times radius of the given circular loop from the center on its axis is B_2. The value of B_1/B_2 will be: [JEE Main-2022]

1. $9 : 4$
2. $12 : \sqrt{5}$
3. $8 : 1$
4. $5 : \sqrt{3}$

Ans : (3)

QUESTION

A proton, a deuteron and α-particle with same kinetic energy enter into a uniform magnetic field at right angle to magnetic field. The ratio of the radii of their respective circular paths is: [JEE Main-2022]

(1) $1:\sqrt{2}:\sqrt{2}$

(2) $1:1:\sqrt{2}$

(3) $\sqrt{2}:1:1$

(4) $1:\sqrt{2}:1$

Ans : (4)

QUESTION

A long straight wire with a circular cross-section having radius R, is carrying a steady current I. The current I is uniformly distributed across this cross-section. Then the variation of magnetic field due to current I with distance r $(r < R)$ from its centre will be:

[JEE Main-2022]

1. $B \propto r^2$

2. $B \propto r$

3. $B \propto 1/r^2$

4. $B \propto 1/r$

Ans : (2)

QUESTION

A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is halved, the new value of magnetic field will be equal to: [JEE Main-2022]

(1) B

(2) $2B$

(3) $4B$

(4) $B/2$

Ans : (1)

QUESTION

A proton and an alpha particle of the same velocity enter in a uniform magnetic field which is acting perpendicular to their direction of motion, The ratio of the circular paths described by the alpha particle and proton is: [JEE Main-2022]

(1) 1 : 4

(2) 4 : 1

(3) 2 : 1

(4) 1 : 2

Ans : (4)

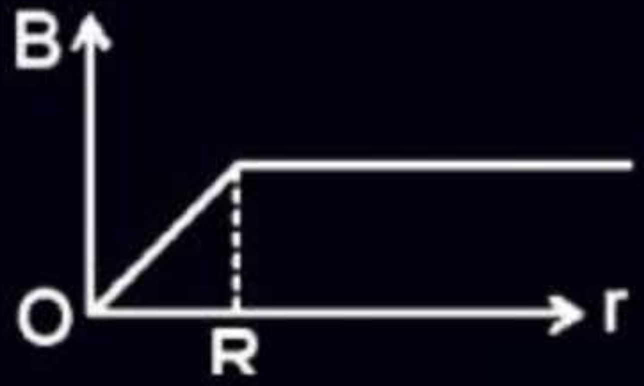
QUESTION

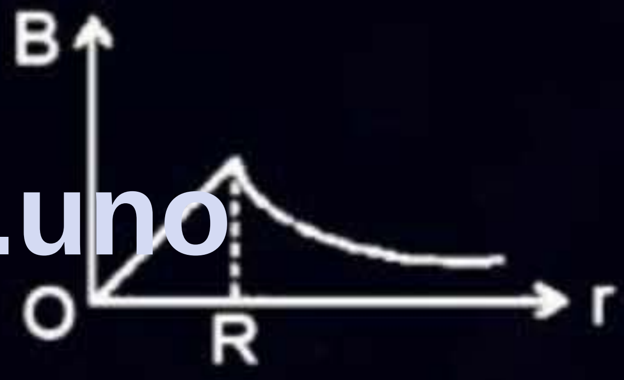
A deutron and a proton moving with equal kinetic energy enter into to a uniform magnetic field at right angle to the field. If r_d and r_p are the radii of their circular paths respectively, then the ratio r_d/r_p will be $\sqrt{x}:1$ where x is ______. **[JEE Main-2022]**

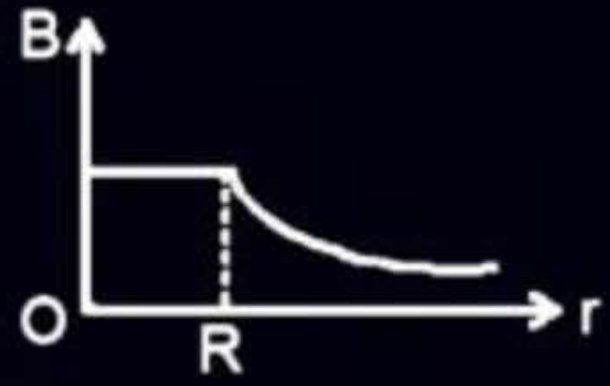
Ans : (2)

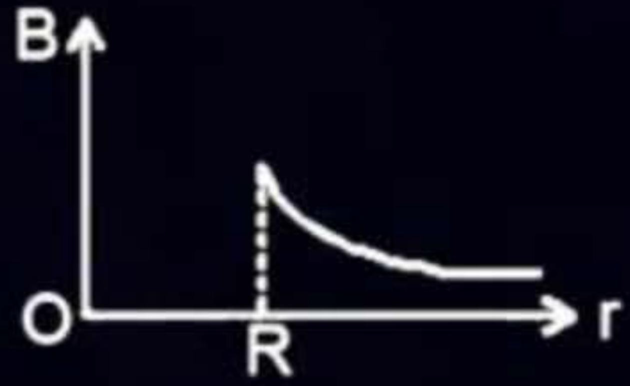
QUESTION

An infinitely long hollow conducting cylinder with radius R carries a uniform current along its surface. Choose the correct representation of magnetic field (2) as a function of radial distance (r) from the axis of cylinder. **[JEE Main-2022]**

(1) 

(2) 

(3) 

(4) 

Ans : (4)

QUESTION

A singly ionized magnesium atom ($A = 24$) ion is accelerated to kinetic energy 5 keV and is projected perpendicularly into a magnetic field B of the magnitude 0.5 T. The radius of path formed will be _____ cm. [JEE Main-2022]

Ans : (10)

QUESTION

A circular loop of radius r is carrying current I A. The ratio of magnetic field at the centre of circular loop and at a distance r from the center of the loop on its axis is:

[24 January 2023 - Shift 1]

(1) $1 : 3\sqrt{2}$

(2) $3\sqrt{2} : 2$

(3) $2\sqrt{2} : 1$

(4) $1 : \sqrt{2}$

Ans : (3)

QUESTION

A long solenoid is formed by winding 70 turns cm^{-1}. If 2.0 A current flows, then the magnetic field produced inside the solenoid is ______.
($\mu_0 = 4\pi \times 10^{-7}\ TmA^{-1}$).
[24 January 2023 - Shift 2]

1. 1232×10^{-4} T
2. 176×10^{-4} T
3. 352×10^{-4} T
4. 88×10^{-4} T

Ans : (2)

QUESTION

A long straight wire of circular cross-section (radius a) is carrying steady current I. The current I is uniformly distributed across this cross-section. The magnetic field is:

[06 April 2023 - Shift 1]

1. inversely proportional to r in the region r < a and uniform throughout in the region r > a.

2. directly proportional to r in the region r < a and inversely proportional to r in the region r > a.
3. Zero in the region r < a and inversely proportional to r in the region r > a.
4. uniform in the region r < a and inversely proportional to distance r from the axis, in the region r > a.

Ans : (2)

QUESTION

A proton with a kinetic energy of 2.0 eV moves into a region of uniform magnetic field of magnitude $\frac{\pi}{2} \times 10^{-3}$ T. The angle between the direction of magnetic field and velocity of proton is 60°. The pitch of the helical path taken by the proton is ______cm. (Take, mass of proton = 1.6×10^{-27} kg and charge on proton = 1.6×10^{-19} C).

[06 April 2023 - Shift 2]

Ans : (40)

QUESTION

A charge particle moving in magnetic field B, has the components of velocity along B as well as perpendicular to B. The path of the charge particle will be:

[08 April 2023 - Shift 1]

1. helical path with the axis perpendicular to the direction of magnetic field B
2. helical path with the axis along magnetic field B
3. circular path
4. straight along the direction of magnetic field B

Ans : (2)

QUESTION

The ratio of magnetic field at the centre of a current carrying coil of radius r to the magnetic field at distance r from the centre of coil on its axis is $\sqrt{x} : 1$. The value of x is ______.

[08 April 2023 - Shift 2]

Ans : (8)

QUESTION

An electron is allowed to move with constant velocity along the axis of current carrying straight solenoid.

(A) The electron will experience magnetic force along the axis of the solenoid.

(B) The electron will not experience magnetic force.

(C) The electron will continue to move along the axis of the solenoid.

(D) The electron will be accelerated along the axis of the solenoid.

(E) The electron will follow parabolic path inside the solenoid.

Choose the correct answer from the option given below: **[11 April 2023 - Shift 2]**

1. B, C and D only
2. A and D only
3. B and C only
4. B and E only

Ans : (3)

QUESTION

An electron is moving along the positive x-axis. If uniform magnetic field is applied parallel to the negative z-axis, then

A. The electron will experience magnetic force along positive y-axis

B. The electron will experience magnetic force along negative y-axis

C. The electron will not experience any force in magnetic field

D. The electron will continue to move along the positive x-axis

E. The electron will move along circular path in magnetic field

Choose the correct answer from the option given below: **[13 April 2023 - Shift 2]**

1. A and E only
2. C and D only
3. B and E only
4. B and D only

Ans : (3)

QUESTION

A charge of 4.0 μC is moving with a velocity of 4.0×10^6 ms^{-1} along the positive *y*-axis under a magnetic field $\vec{B}$ of straight $(2\hat{k})$ T. The force acting on the charge is $x\,\hat{i}$ N. The value of *x* is ______. **[29 Jan. 2024 - Shift 2]**

Ans : (32)

QUESTION

An electron moves through a uniform magnetic field $\vec{B} = B_0\hat{i} + 2B_0\hat{j}$ T. At a particular instant of time, the velocity of electron is $\vec{u} = 3\hat{i} + 5\hat{j}$ m/s. If the magnetic force acting on electron is $\vec{F} = 5\,e\hat{k}$N, where e is the charge of electron, then the value of B_0 is ______ T.

[31 Jan. 2024 - Shift 1]

Ans : (5)

QUESTION

An electron is projected with uniform velocity along the axis inside a current carrying long solenoid. Then: [04 Apr. 2024 - Shift 1]

1. the electron will continue to move with uniform velocity along the axis of the solenoid.

2. the electron will be accelerated along the axis.

3. the electron path will be circular about the axis.

4. the electron will experience a force at $45°$ to the axis and execute a helical path.

Ans : (1)

QUESTION

In a co-axial straight cable, the central conductor and the outer conductor carry equal currents in opposite directions. The magnetic field is zero: [05 Apr. 2024 - Shift 1]

(1) outside the cable

(2) inside the outer conductor

(3) inside the inner conductor

(4) in between the two conductors

Ans : (1)

QUESTION

The electrostatic force $(\vec{F_1})$ and magnetic force $(\vec{F_2})$ acting on a charge q moving with velocity v can be written: [05 Apr. 2024 - Shift 2]

(1) $\vec{F_1} = q\vec{E}, \vec{F_2} = q(\vec{V} \times \vec{B})$

(2) $\vec{F_1} = q\vec{B}, \vec{F_2} = q(\vec{B} \times \vec{V})$

(3) $\vec{F_1} = q\vec{E}, \vec{F_2} = q(\vec{B} \times \vec{V})$

(4) $\vec{F_1} = q\vec{V} \cdot \vec{E}, \vec{F_2} = q(\vec{B} \cdot \vec{V})$

Ans : (1)

QUESTION

A solenoid of length 0.5 m has a radius of 1 cm and is made up of 'm' number of turns. It carries a current of 5 A. If the magnitude of the magnetic field inside the solenoid is 6.28×10^{-3} then the value of m is ______. [05 Apr. 2024 - Shift 2]

Ans : (500)

QUESTION

A long straight wire of radius a carries a steady current I. The current is uniformly distributed across its cross section. The ratio of the magnetic field at a/2 and 2a from axis of the wire is: [08 Apr. 2024 - Shift 2]

(1) 1 : 4

(2) 1 : 1

(3) 3 : 4

(4) 4 : 1

Ans : (2)

QUESTION

A proton and a deutron ($q = +e$, $m = 2.0$ u) having same kinetic energies enter a region of uniform magnetic field $\vec{B}$, moving perpendicular to $\vec{B}$. The ratio of the radius r_d of deutron path to the radius r_p of the proton path is: [09 Apr. 2024 - Shift 2]

(1) $\sqrt{2} : 1$

(2) $1 : 1$

(3) $1 : \sqrt{2}$

(4) $1 : 2$

Ans : (1)

Home work

- JA, irodov, JM Qun are attached.


THANK
YOU
ATDB.uno