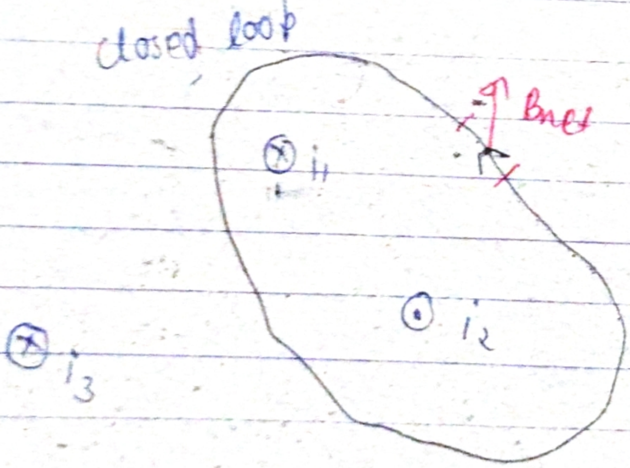
Ampere circutal law =>



$$\oint \vec{B} \cdot \vec{dl} = \mu_0 I_{in}$$

m.f. due to all the wires

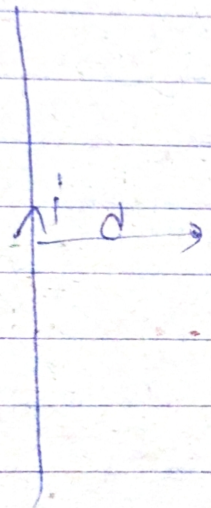
$\cancel{i_1 + i_2}$

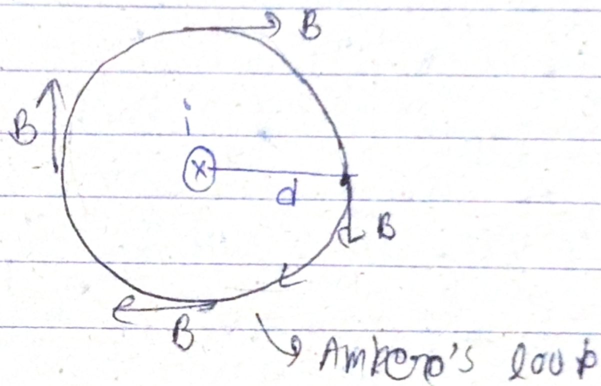
$i_2 - i_1$

not $i_1 - i_2$

Ampere's circuital law is valid every where but practically it is not possible to calculate M.f. using circuital law. it is only possible for highly symmetrical cases.

MF due to infinite current carrying wire.





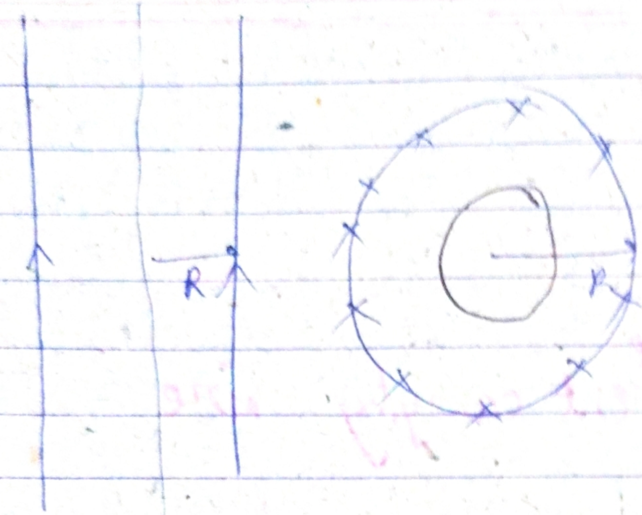
$$\oint \vec{B} \cdot \vec{dl} = \mu_0 I_{in}$$

$$B \int dl \cos\theta = \mu_0 I$$

$$B \cdot 2\pi d = \mu_0 I$$

$$B = \frac{\mu_0 I}{2\pi d}$$

Hollow infinite wire



$r > R$

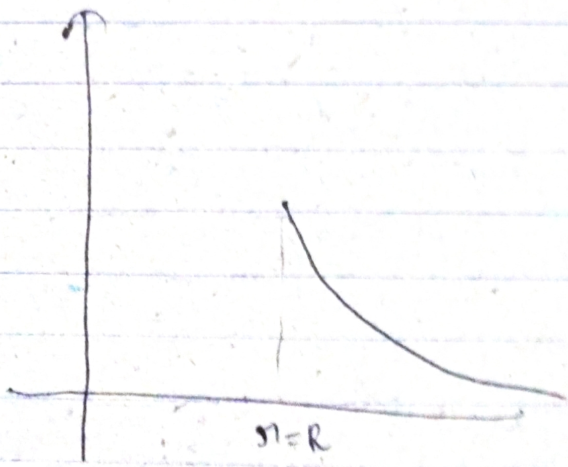
$$\boxed{B = \frac{\mu_0 I}{2\pi R}}$$

$r < R$

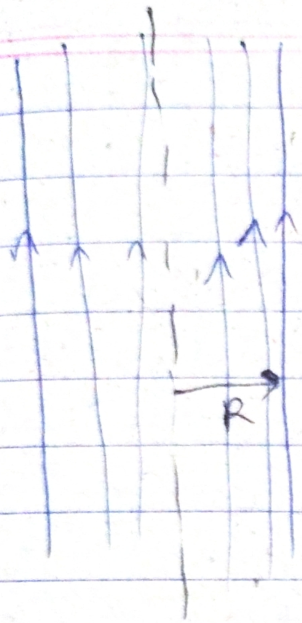
$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

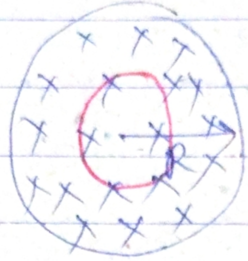
$$B \cdot 2\pi r = \mu_0 \times 0$$

$$\boxed{B = 0}$$



Solid infinite wire





$r > R$

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

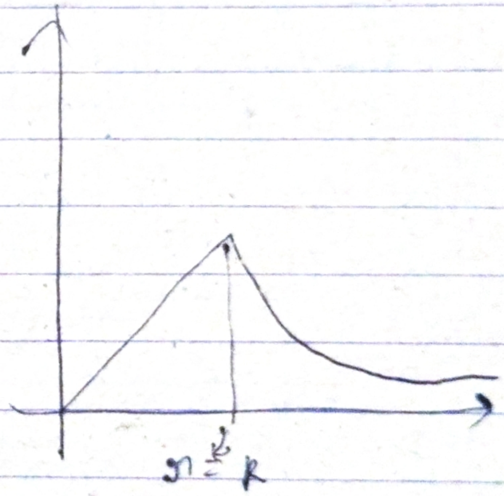
$$j = \frac{i}{\pi R^2}$$

$r < R$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{in}$$

$$B \, 2\pi \cancel{r} = \mu_0 \, j \times \pi r^{\cancel{2}}$$

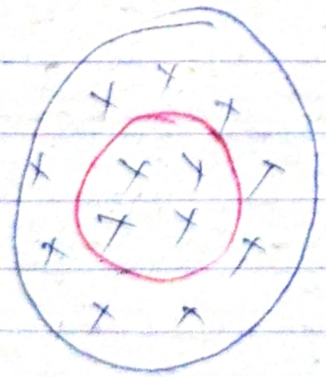
$$\boxed{B = \frac{\mu_0 j r}{2}}$$



~~$B \cdot 2\pi r = \mu_0 j \times \pi R^2$~~

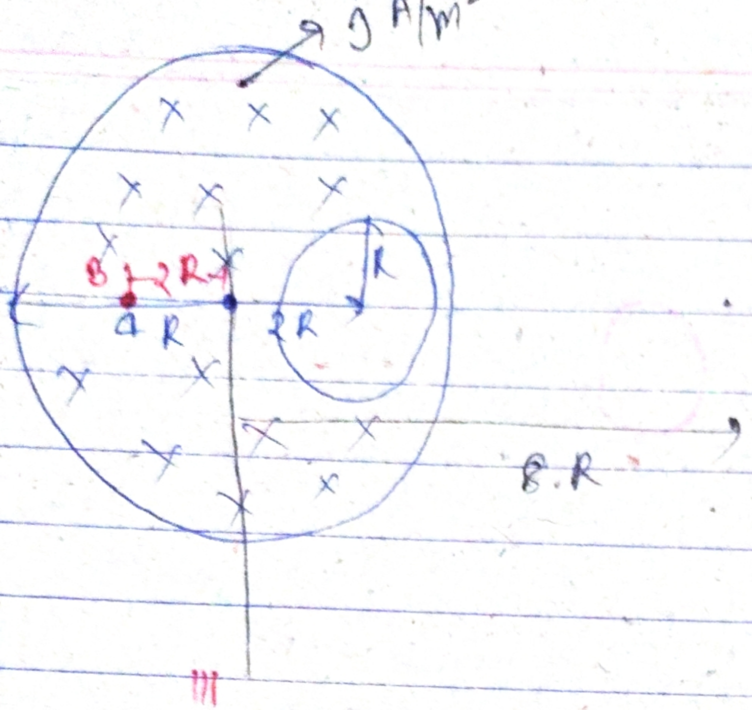
~~$B = \mu_0$~~

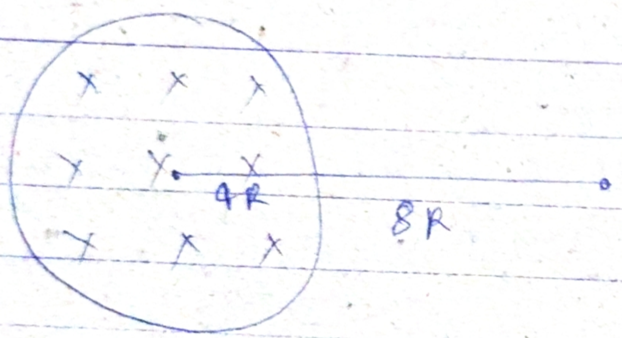
Qu



$j(r)$ -

Q)

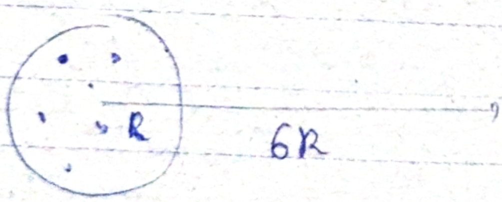




$$\frac{\mu_0 \, j \, \cancel{\pi} \, 16R^{2}}{2 \cancel{\pi} \, 8 \, \cancel{R}}$$

$$\mu_0 R J$$

+



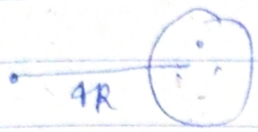
$$\frac{\mu_0 \, \cancel{\pi} R^{2} \, j}{12 \cancel{\pi} \, R}$$

$$= \frac{\mu_0 R J}{12}$$

$$\mu_0 R J - \frac{\mu_0 R J}{12}$$

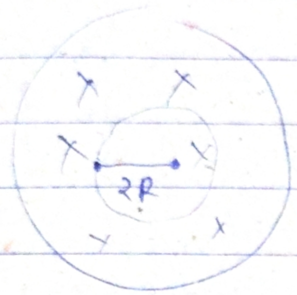
$$\mu_0 R J \left(1 - \frac{1}{12}\right) = \frac{11}{12} \mu_0 R J$$

For point B



$$\frac{\mu_0 J \pi r^2 \hat{j}}{8 \pi R} = \frac{\mu_0 r \hat{j}}{8}$$

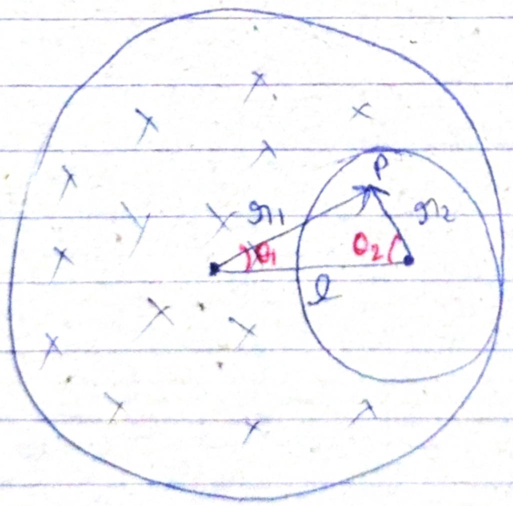
+



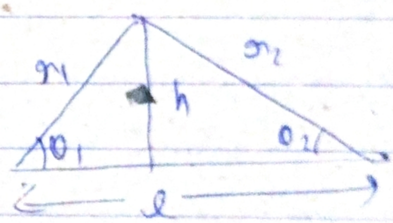
$$\frac{\mu_0 J \hat{j} \times r}{\lambda} = \mu r \hat{j}$$

$$\mu_0 R J \left(\frac{7}{8}\right)$$

III case most imp.

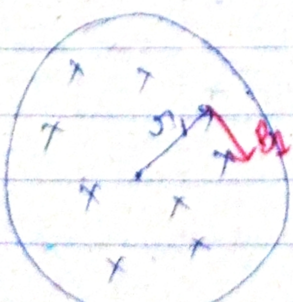


=



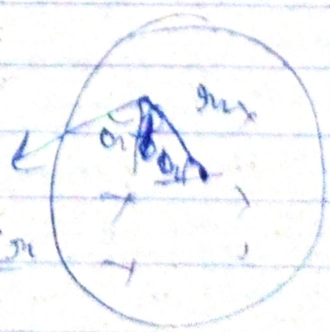
$h = r_1 \sin\theta_1 = r_2 \sin\theta_2$

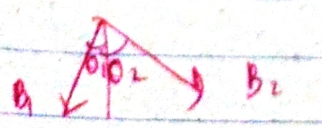
|||



$B_1 = \frac{\mu_0 J r_1}{2}$

+ B_2 = $\frac{\mu_0 J r_2}{2}$





$B_H = B_2 \sin\theta_2 - B_1 \sin\theta_1$

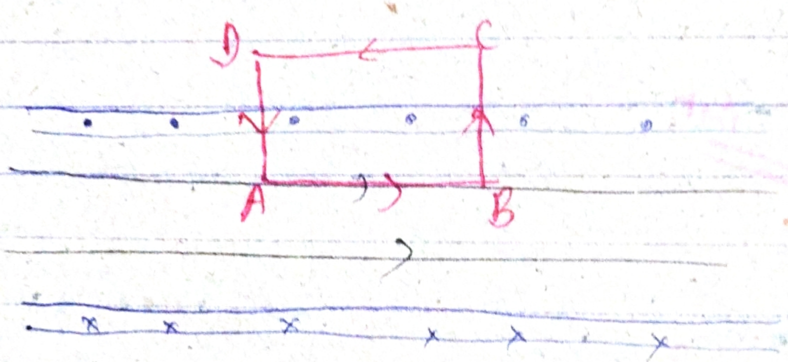
$= \frac{\mu_0 J}{2}(r_2 \sin\theta_2 - r_1 \sin\theta_1) = 0$

$$B_V = B_2 \cos\theta_2 + B_1 \cos\theta_1$$

$$= \frac{\mu_0 j}{2} (r_2 \cos\theta_2 + r_1 \cos\theta_1)$$

$$\boxed{= \frac{\mu_0 j l}{2}}$$: constant

Magnetic field due to ideal solenoid using Amperes circutal law ⇒



n = no of turns per unit length

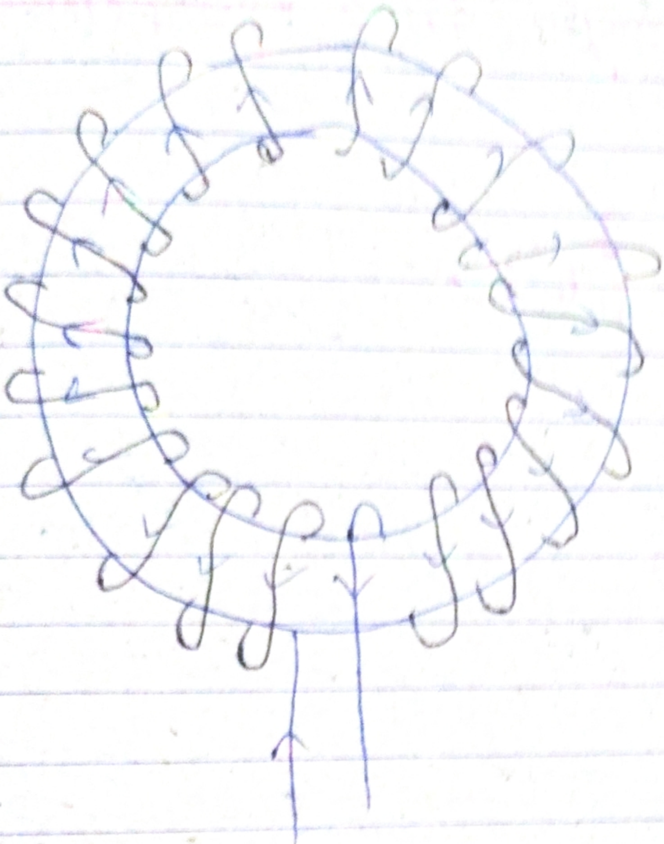
$$\oint \vec{B} \cdot \vec{dl} = \mu_0 I_{in}$$

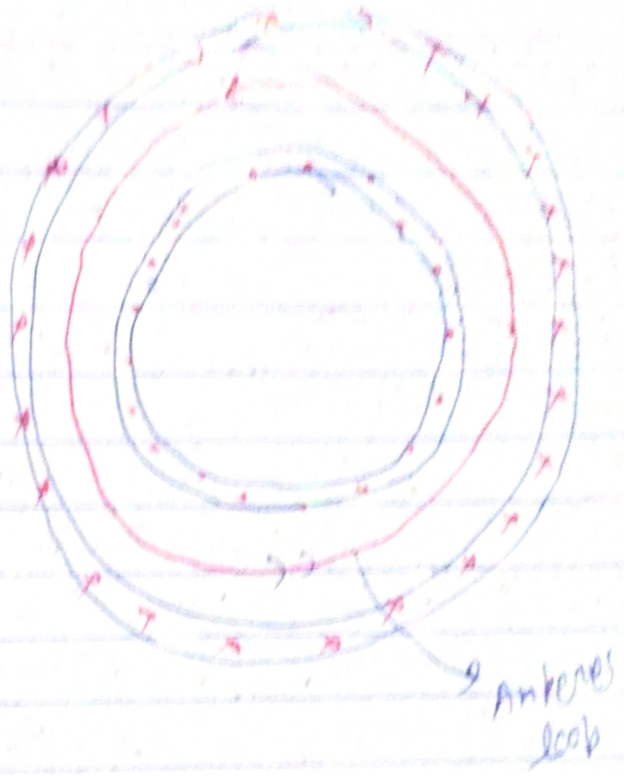
AB BC CD DA

$$Bl + 0 + 0 + 0 = \mu_0 I\, nl$$

$$\boxed{B = \mu_0 n I}$$

Toroid





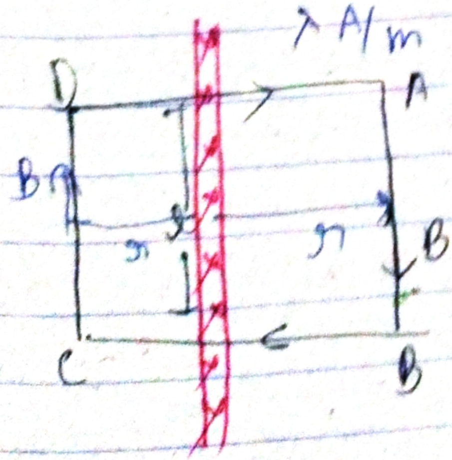
N = total turns n = no of turns / length = $\frac{N}{2\pi R}$

$$\oint \vec{B}\cdot \vec{dl} = \mu_0 I_{in}$$

$$B \cdot 2\pi R = \mu_0 N I$$

$$B = \frac{\mu_0 N I}{2\pi R} = \mu_0 n I$$

infinite sheet



$$\oint B \cdot dl = \mu_0 I_{in}$$

$\downarrow$

AB BC CD DA

$\downarrow$

$$Bl + 0 + Bl + 0 = \mu_0 \lambda l$$

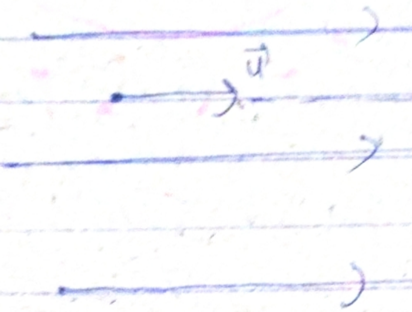
$$\boxed{B = \frac{\mu_0 \lambda}{2}}$$

force on a moving charge in a magnetic field

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

with sign

① if $\vec{v} \parallel \vec{B}$

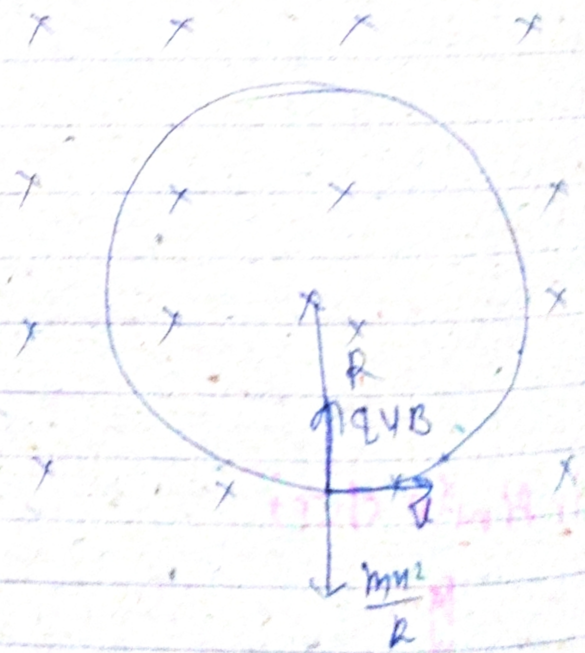


② if $\vec{v} \perp \vec{B}$

$$F = q\,\vec{v} \times \vec{B}$$

$$|\vec{F}_m| = qvB$$

$$\vec{F}_m \perp \vec{v}$$



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

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

$$T = \frac{2\pi R}{v} = \frac{2\pi m}{qB}$$ → independent of v

$$f = \frac{qB}{2\pi m} \qquad \omega = \frac{qB}{m}$$

ex:

$\vec{B} = B_0 \hat{i}$ $\vec{g}, (\hat{6}) = 1$

$\vec{u} = v_0 \hat{j}$

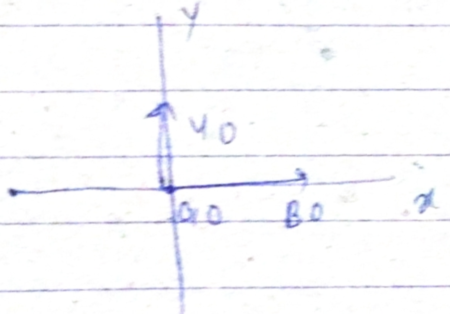
q, m

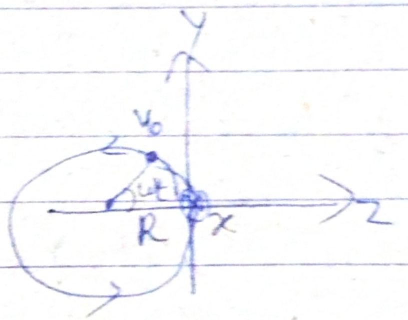
$(0,0)$ $F = q\, v\hat{j} \times B\hat{i}$

$= q\, vB\, -\hat{k}$

$$q\, v\, B = \frac{mv^2}{R}$$

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





$$\begin{cases} x = 0 \\ y = \frac{mv}{qB} \sin\left(\frac{qB}{m}t\right) \\ z = \frac{mv}{qB}\left(1 - \cos\left(\frac{qB}{m}\right)t\right) \end{cases}$$

ex

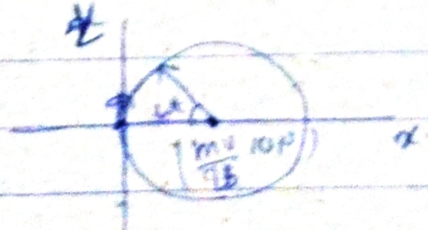
$\vec{B} = -B_0 \hat{j}$

$\vec{u} = u_0 \hat{k}$. $F = q\, \vec{v} \times \vec{B}$

$\hat{k} \times \hat{j}$

q, m $(0,0)$ $= qvB\, \hat{i}$

$\vec{g} = t$



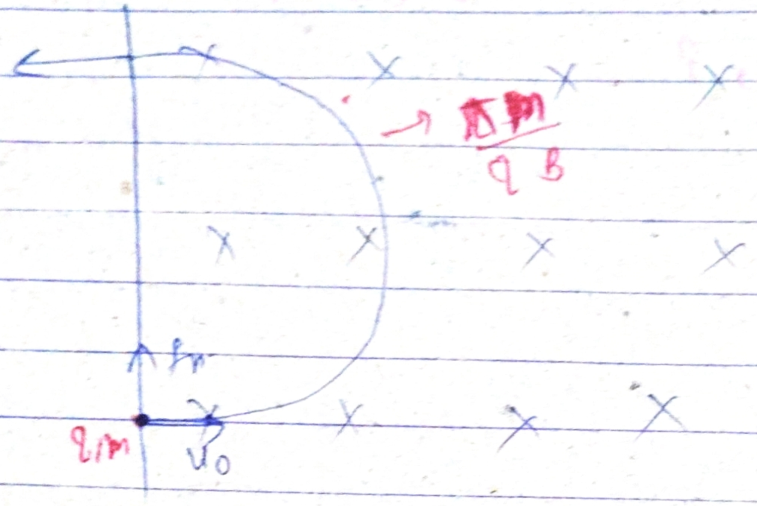
$y = 0$

$z = \frac{mv}{qB}$ ~~$z=$~~ $\sin \frac{qB}{m} t$

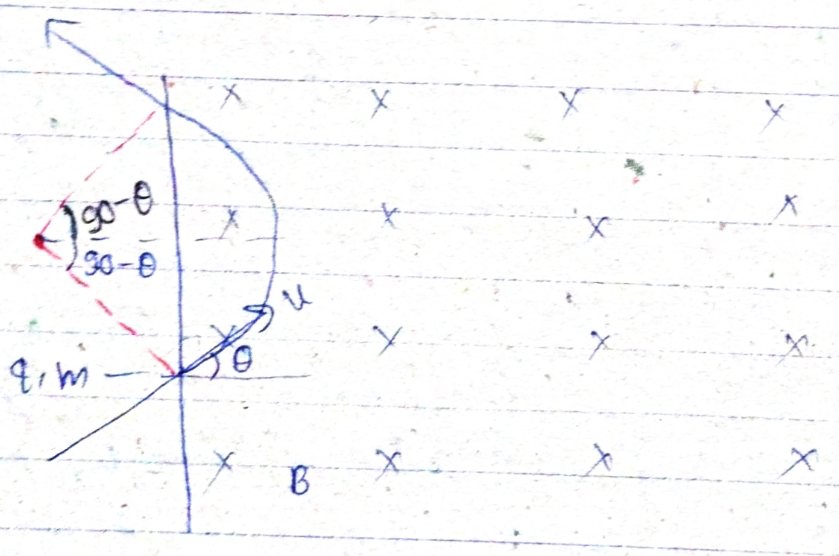
$x =$

$x = \frac{mv}{qB}\left(1 - \cos \frac{qB}{m} t\right)$

find out the time spent by the charge in magnetic field ⇒



find out the time spent by the particle in magnetic field



$\boxed{\text{angle} = \omega t}$

$180 - 2\theta = \omega t$

$\pi - 2\theta = \frac{qB}{m} t$