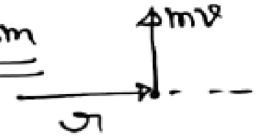
⇒ **Magnetic moment**: due to Current Carrying Loop

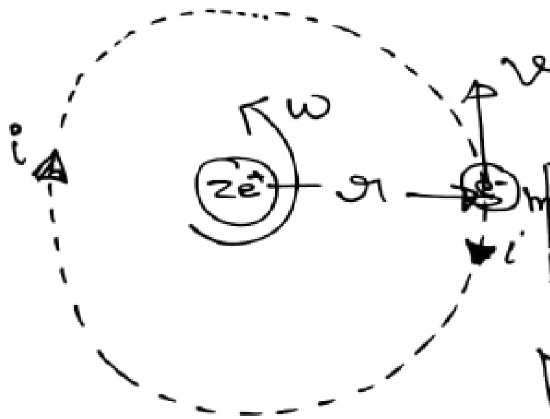
⇒ **Atomic Magnetism**



$$i = \frac{q}{T} = \frac{e}{\frac{2\pi r}{v}}$$

$$\left|\frac{M}{L}\right| = \frac{e}{2m}$$

$$i = \frac{ev}{2\pi r} \qquad i = \frac{e\omega}{2\pi}$$



v [speed] ⇓ Constant

$$\omega = \frac{v}{r}$$

$$i = \frac{q}{T} \qquad \frac{1}{T} = f$$

$$i = qf$$

Angular momentum

$$\vec{L} = \vec{r} \times \vec{p}$$

$$L = rmv \sin 90$$

$$\vec{L} = mvr(\hat{k})$$

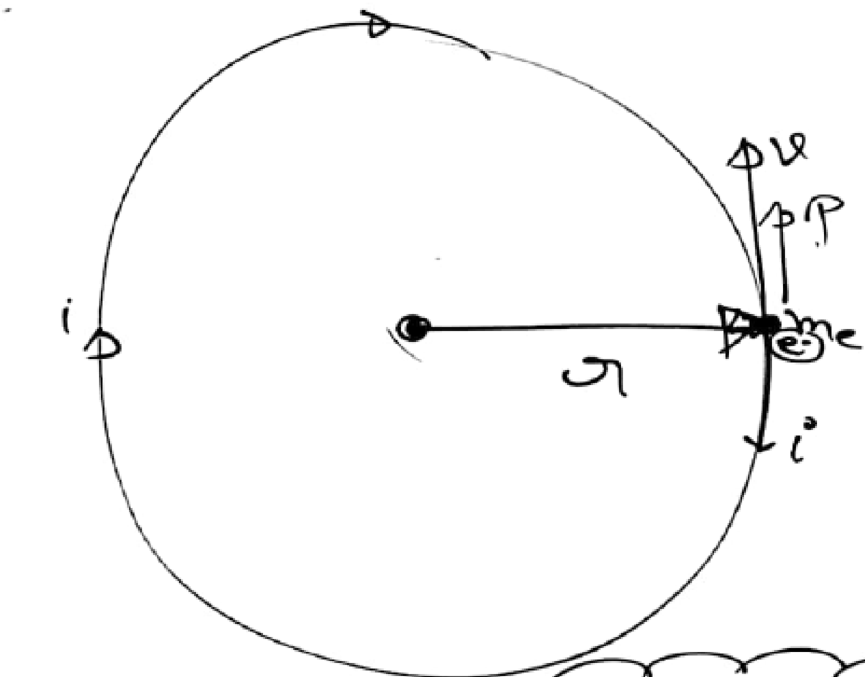
$$M = iA$$

$$\vec{M} = \frac{evr}{2}(-\hat{k}) \qquad M = \frac{ev}{2\pi r} \times \pi r^2 = \frac{evr}{2}$$

$$\frac{\vec{M}}{\vec{L}} = \frac{-evr}{2 \times mvr} = \frac{-e}{2m}$$

$$\vec{M} = \frac{-e}{2m}\vec{L}$$

⇒ Magnetic moment : due to Current Carrying Loop



$$\vec{M} = \frac{evr}{2} \otimes$$

$$\vec{L} = \vec{r} \times \vec{p}$$

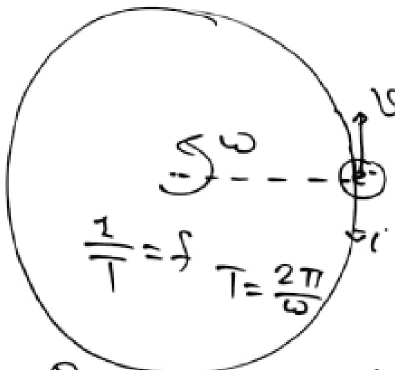
$$= r\, m v \sin 90^\circ$$

$$\vec{L} = mvr \odot$$

$$\frac{M}{L} = \frac{e}{2m}$$

$$\vec{M} = -\frac{e}{2m_e}\vec{L}$$

Q1) An electron is revolving in a circular path of radius 20 Å & frequency 2×10^{15} rps. then find
(i) current produced by it.
(ii) magnetic field at centre.
(iii) its magnetic moment.



$r = 20\times10^{-10}\,m$

$r = 2\times10^{-9}\,m$

$i = \frac{e}{T} = ef$

$i = 1.6\times10^{-19}\times2\times10^{15}$

$= 3.2\times10^{-4}\,A$

$= .32\times10^{-3}\,A$

$\boxed{i = .32\,mA}$

$i = \frac{e}{T} = ef$

$i = \frac{e}{\frac{2\pi r}{v}} = \frac{ev}{2\pi r}$

$\boxed{i = ef}$

$\boxed{i = \frac{e\omega}{2\pi} = \frac{e\omega}{2\pi}}$

(ii) $B = \frac{\mu_0 i}{2R}$

$B = \frac{4\pi\times10^{-7}\times3.2\times10^{-4}}{2\times2\times10^{-9}}$

$= 3.2\pi\times10^{+9-7-4}$

$\boxed{B = 3.2\pi\times10^{-2}\ \text{Tesla}}$

(iii) $M = iA$

$= 3.2\times10^{-4}\times\pi\times(2\times10^{-9})^2$

$= 3.2\times10^{-4}\times\pi\times4\times10^{-18}$

$\boxed{M = 4\pi\times3.2\times10^{-22}\ A\text{-}m^2}$

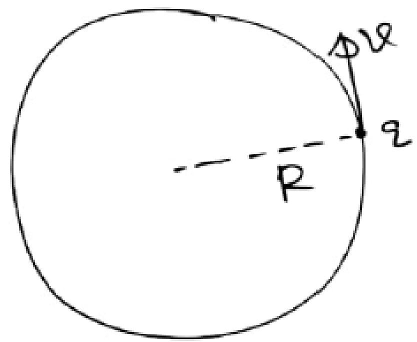
AIPMT 2007 :- A charged particle (q) is moving in a circle of radius R with uniform speed v. The associated magnetic moment μ is given by.

(i) qvR.

(ii) $\frac{qvR}{2}$. ✓

(iii) qvR^2.

(iv) $\frac{qvR^2}{2}$.



$$i = \frac{q}{T}$$

$$i = \frac{q}{\frac{2\pi R}{v}}$$

$$i = \frac{qv}{2\pi R}$$

$$\mu = iA$$

$$= \frac{qv}{2\pi R} \times \pi R^2 = \boxed{\frac{qvR}{2}}$$

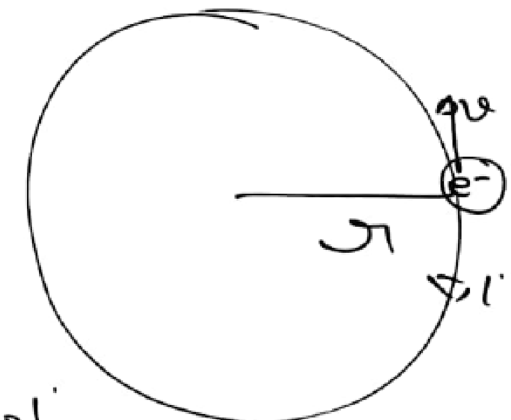
2015) An electron moving in a circular orbit of radius r makes n rotations per second. The magnetic field produced at the centre has magnitude is.

(1) zero.

(b) $\frac{\mu_0 n^2 e}{r}$.

(c) $\frac{\mu_0 n e}{2r}$. ✓

(iv) $\frac{\mu_0 n i}{2\pi r}$.



$f = n$

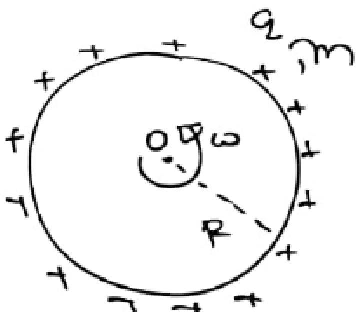
$i = \frac{e}{T} = en$

$\Rightarrow i = en$

$$B = \frac{\mu_0 i}{2r} = \frac{\mu_0 e n}{2r}$$

$$\Rightarrow \quad \frac{M}{L} = \frac{q}{2m}$$

⇒ ring



Moment of Inertia = mR^2

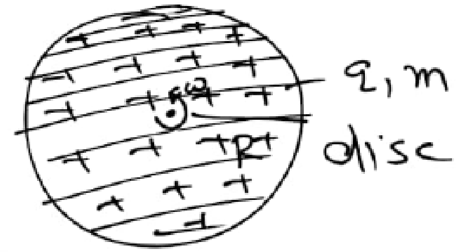
$$\frac{M}{L} = \frac{q}{2M}$$

$$M = \frac{q}{2m}\left[I\omega\right]$$

$$M = \frac{q}{2m}\left[mR^2\omega\right]$$

$$\boxed{M = \frac{q\omega R^2}{2}}$$

#



find magnetic moment

$$L = I\omega$$

$$L = \left(\frac{mR^2}{2}\right)\omega$$

$$\frac{M}{L} = \frac{q}{2m}$$

$$M = \frac{q}{2m} \times L$$

$$M = \frac{q}{2m} \times \frac{mR^2}{2}\omega$$

$$M = \frac{q\omega R^2}{4}$$

Bohr's magneton :- (μ_B) :-

Bohr's magneton is define as magnetic moment of revolving electron is first orbit of atom.

↳ Electron move only these orbitals whose angular momentum $L = \frac{nh}{2\pi}$ $[n \in I^+, n \in 1, 2, --]$

$n = 1$, $L = \frac{h}{2\pi}$

$n = 1$

$$\frac{\mu}{L} = \frac{e}{2m_e}$$

$$\mu_B = \frac{e}{2m_e} L$$

[h = plank's constant]

[h = 6.67 × 10^{-34} J-sec]

[$\hbar$] = AIPMT

$$\mu_B = \frac{e}{2m_e} \times \frac{h}{2\pi}$$

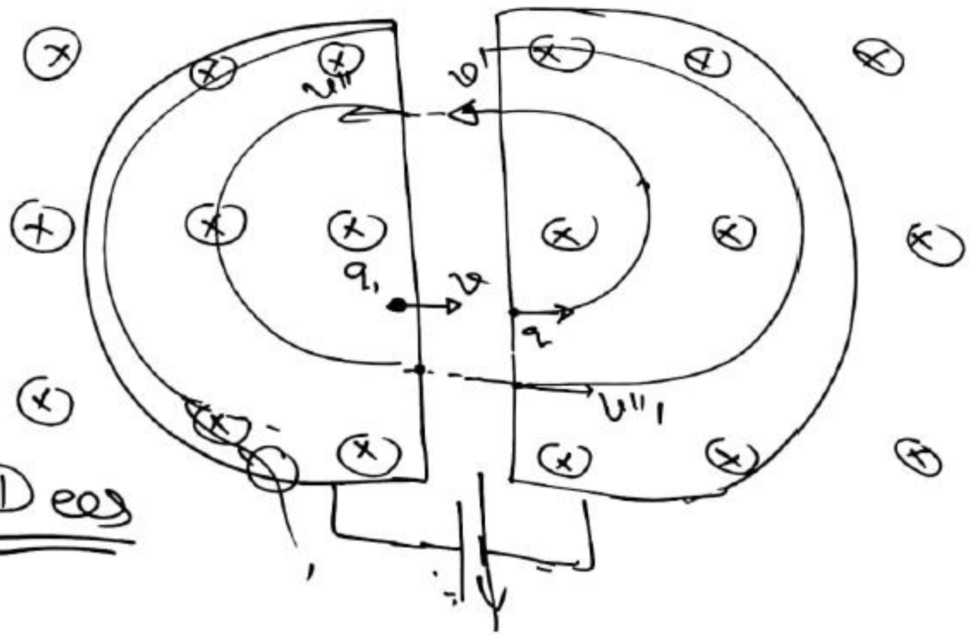
$$\mu_B = \frac{eh}{4\pi m_e}$$

$$\mu_B = \frac{1.6 \times 10^{-19} \times 6.67 \times 10^{-34}}{4\pi \times 9.1 \times 10^{-31}}$$

$$\mu_B = 0.923 \times 10^{-23} \text{ A-m}^2$$

Cyclotron:-

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



Dees