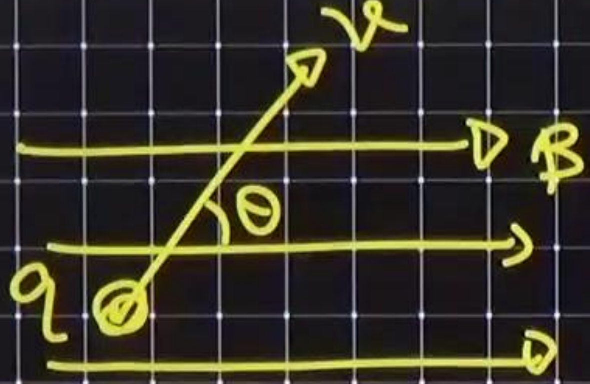
Magnetic force :-



$$\vec{F}_m = q[\vec{v} \times \vec{B}]$$

$$F_m = qvB\sin\theta$$

θ = angle b/w magnet
field & velocity ve

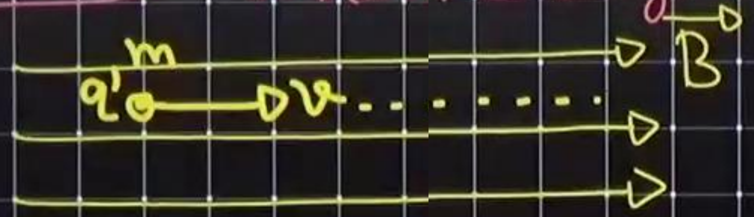
$$\vec{F}_m \perp \vec{v}$$

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

$$P = \vec{F}_m \cdot \vec{v} = 0$$

$$W = 0$$

⇒ (i) Case I) When charge move in dir^n of magnetic field



$\theta = 0$ [charge particle move in dir^n of magnetic field

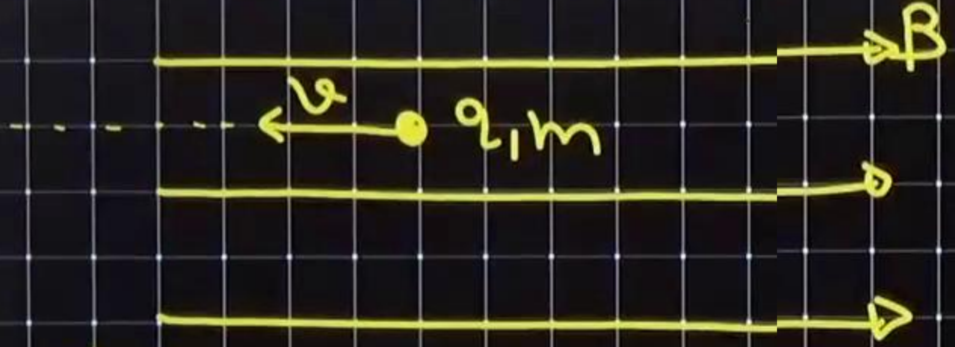
$$F_m = q v B \sin\theta$$

$$F_m = q v B \sin 0$$

$$F_m = 0$$

↳ Path → St-line with Constant velocity.

Case 2:- When charge particle project with velocity v in opposite to dirn of magnetic field.



move in st-line with constant velocity

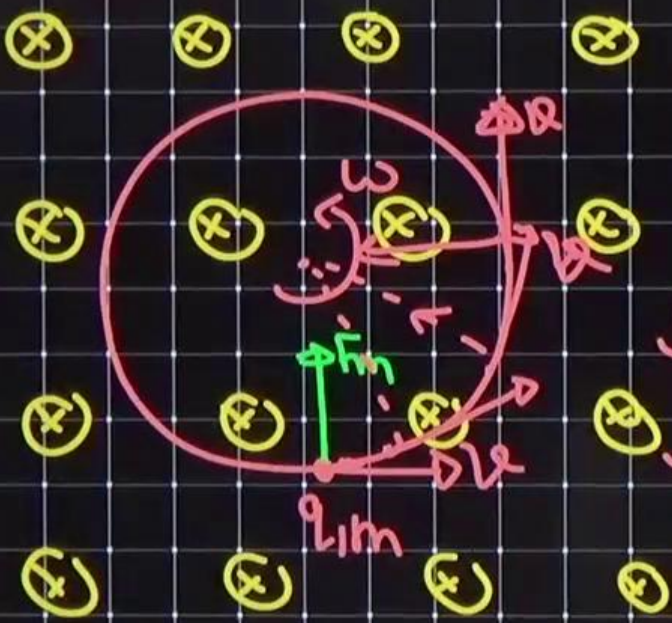
(i) $\theta = 180^\circ$, $\vec{F}_m = q\,\vec{v}\times\vec{B}$

$$F_m = qvB\sin 180^\circ = 0$$

Path: st-line

Case III) Particle project perpendicular to magnetic field.

$\vec{v} \perp \vec{B} \Rightarrow \theta = 90$.



$F_m = qvB \sin 90 = qvB$.

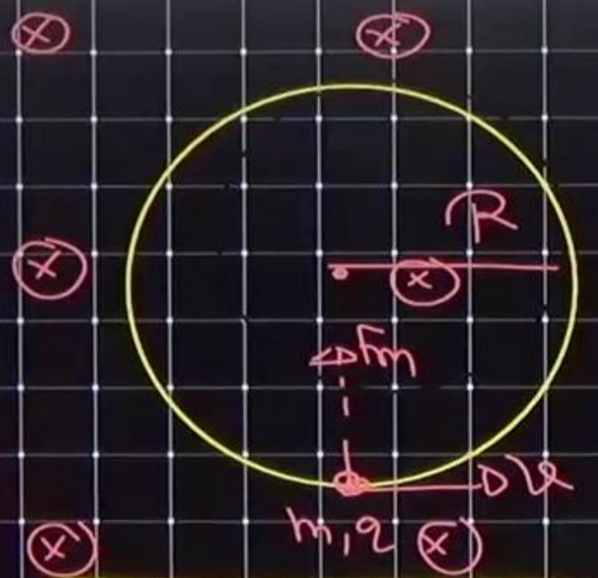
↳ Path → Circular.

(i) Radius of circular path

(ii) Time period (T)

(iii) ω (iv) f.

B



$$F_m = qvB$$

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

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

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

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

↦ Time period

$$T = \frac{2\pi R}{v}$$

(**) Time period does not depends on velocity.

$$T = \frac{2\pi}{v}\left[\frac{mv}{qB}\right]$$

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

$$T \propto m$$

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

$$T \propto \frac{1}{B}$$

$$T \propto v^0$$

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

$$R = \frac{mv}{qB} = \frac{P}{qB} = \frac{\sqrt{2mK}}{qB} = \frac{\sqrt{2mqV}}{qB}$$

→ A particle (→ Charge) project perpendicular to magnetic field wit[h] kinetic energy K

$$K = \frac{1}{2} mv^2 \times \frac{m}{m}$$

$$K = \frac{1}{2} \frac{m^2v^2}{m}$$

$$2mK = (mv)^2$$

$$\sqrt{2mK} = mv$$

→ A charge particle (q) accelera[ted] with Potential V in transverse magnetic field. find its Radius of circular path.

→ $K = qV$

Q1) A proton, electron & α-particle of same momen[tum] Project in transverse magnetic field. Which option is corre[ct]

Sol)

(a) $R_\alpha > R_p > R_e$

(b) $R_e > R_p > R_\alpha$

(c) $R_\alpha < R_p = R_e$

(d) $R_p = R_\alpha < R_e$

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

$$R_\alpha = \frac{P}{(2e)B}$$

$$R_p = \frac{P}{eB}$$

$$R_e = \frac{P}{e \times B}$$

$R_p = R_e > R_\alpha$

Q2) A charge (q, m) & $(2q, 4m)$ are accelerated by V (Potential) in Transverse uniform magnetic field. Find Ratio of their radii.

(1) → (q, m) V (2) $(2q, 4m)$ (V)

$K.E_1 = qV$

$(K.E_2) = (2qV)$

$(K.E)_2 = 2qV$

$R = \frac{mv}{qB} = \frac{\sqrt{2mK.E}}{qB}$

$R_1 = \frac{\sqrt{2mqV}}{qB}$

$R_2 = \frac{\sqrt{2(4m)2qV}}{2qB}$

$\frac{R_1}{R_2} = \frac{\frac{\sqrt{2mqB}}{qB}}{\frac{\sqrt{16qVB}}{2qB}} = \frac{2\sqrt{2mqB}}{4\sqrt{mqB}} = \frac{2\sqrt{2}}{4 \times 2}$

$R = \frac{\sqrt{2}}{2} = \frac{\sqrt{2}}{\sqrt{2} \times \sqrt{2}} = \frac{1}{\sqrt{2}}$

(a) A α-particle & Proton move with same velocity in Uniform transverse magnetic field then find ratio of their Radius.

$m_\alpha = 2m_p + 2m_n$

$m_\alpha = 4m_p$

$q_\alpha = 2e^+$

$q_p = e^+$

$$R_\alpha = \frac{m_\alpha v}{q_\alpha B}$$

$$R_p = \frac{m_p \cdot v}{q_p \cdot B}$$

$$R_\alpha = \frac{4 m_p v}{2 e B} = \frac{2 m_p v}{e B}$$

$$R_p = \frac{m_p v}{e B}$$

$$R_\alpha : R_p = 2 : 1$$

A α-particle & proton having same kinetic energy Projected in transverse uniform magnetic field. Find ratio of their radii.

$$R_\alpha = \frac{\sqrt{2[4m_p]K}}{2eB}$$

$$R_p = \frac{\sqrt{2(m_p)K}}{eB}$$

$$\frac{R_\alpha}{R_p} = 1:1$$

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

$$R = \frac{\sqrt{2mK.E}}{qB}$$