Magnetic fields

• **Magnetic force:-** $\vec{F}_B = q\,\vec{v} \times \vec{B}$

$= q\,(v\,B)\,\sin\theta$

θ between V & B

→ Direction of F : you right four fingers is toward V

Then swap your hand towards $\vec{B}$

The Direction of your thumb is the direction

of F_B (right hand rule)

→ If q is negative, The direction of F_B would be the opposite

• **Crossed fields:-**

• When two fields: Magnatec and Electric fields Are perpendicular

• a charge passing through them has both Magnetic and Electric force

• At equilibrium $\boxed{V = \frac{E}{B}}$ velocity

Alaa Hawi

Applications on Magnetic fields

- The Hall effect :- A metal strip

number of carriers per unit volume ↓
$$n = \frac{B\, i}{V_H\, l\, e}$$

Magnetic field

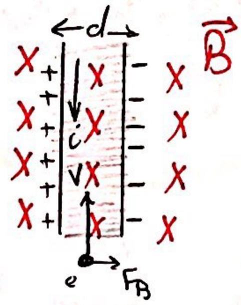
electric current

Hall potential

electric charge

Thickness

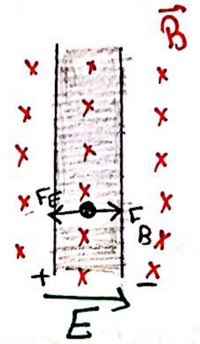
a)



- here a magnetic force F_B affects the drifting electrons and will push them to the

At equilibrium :-

b)



$$V_d = \frac{V_H}{B\, d}$$

drift speed

Potential difference

- electric force is exerted
- equilibrium
- a potential difference is created and is called Hall potential difference (V_H)

- Note that: $\vec{F}_B$ only changes direction of V but doesn't affect it's magnitude

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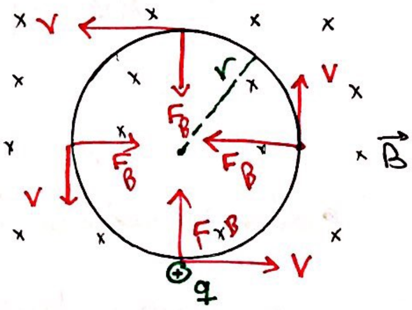
- A circulating Charged particle ($B \perp V$ always)
  - In General $F = ma$
  - In Circular motion $F = m\frac{V^2}{r}$
  - if $F = F_B \rightarrow qVB = m\frac{V^2}{r}$

velocity



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

mass

speed

charge

(Period), $T = \frac{2\pi m}{qB}$

(frequency) $f = \frac{qB}{2\pi m}$

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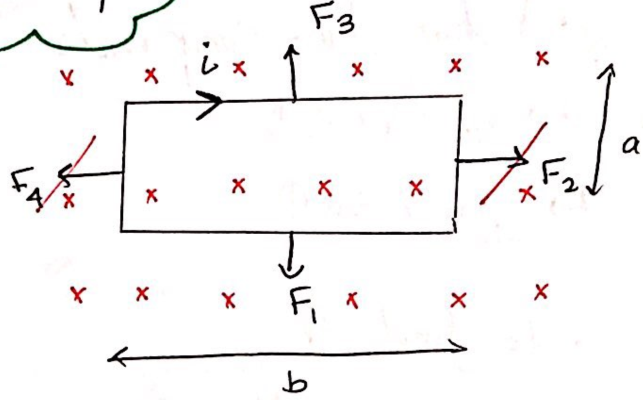
Torque on a Current loop

Number of Turns

of current

$$\tau = N i \vec{A} \times \vec{B}$$

A=ab (Area) magnetic field



- Magnetic Dipole Moment :- ($\vec{\mu}$)

- $\vec{\mu} = N i A$ (Generally) Direction by right hand rule

- When $\vec{B}$ acts on $\vec{\mu}$:

The Torque = $\tau = \vec{\mu} \times \vec{B}$

energy = $U = -\vec{\mu} \cdot \vec{B}$

$W_{\text{of an external Magnetic field}} = {}^{+}\Delta U$

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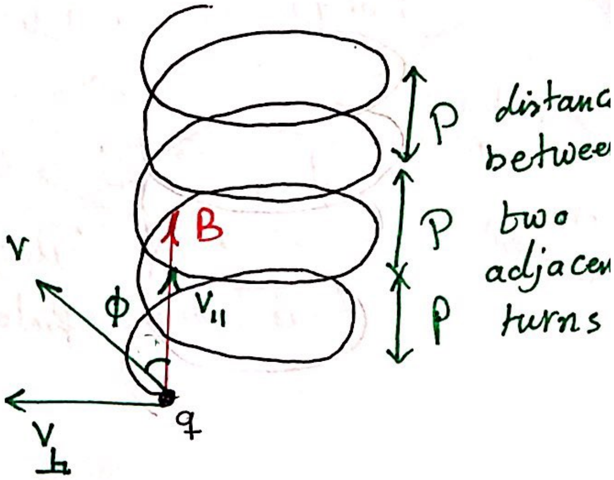
• Helical path

velocity • $\vec{V}$ has two Components

↳ $V_{\parallel} = V\cos\phi$

↳ $V_{\perp} = V\sin\phi$



• to find ϕ

You use the Dot product

$$V.B = V \times B \times \cos\theta$$

velocity

$$\cos\phi = \frac{V.B}{VB}$$ ← vector Notation

Magnitudes

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

• to find pitch

$$P = V_{\parallel} T$$ ↗ period

• to find r :-

$$r = \frac{m V_{\perp}}{qB}$$

• Remember That at equi

$$F_B = F_E$$

$$qE = qvB$$

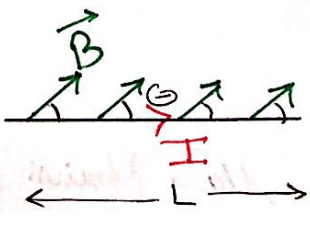
$$\frac{V}{d} = vB$$

$$V = vBd$$

• Magnetic force on a Current Carrying Wire

$$\vec{F}_B = i\,\vec{L} \times \vec{B}$$

direction of the flow of current



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