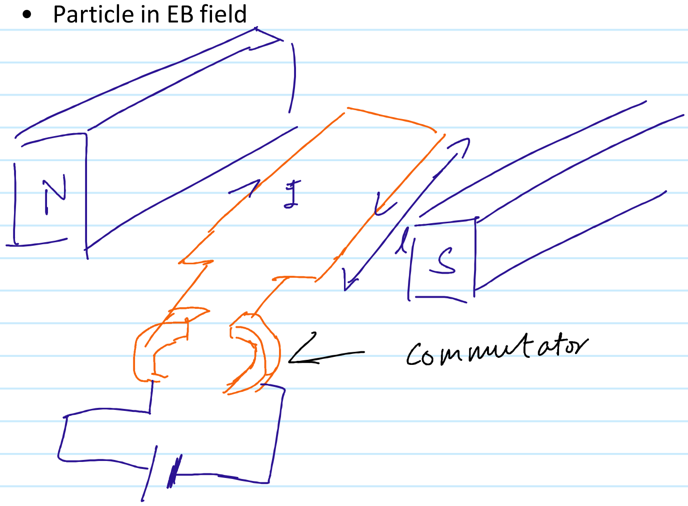
Motor Generator

03 March 2025 09:40

- Motor
- Generator
- Commutator Slip rings
- Particle in EB field



Motor

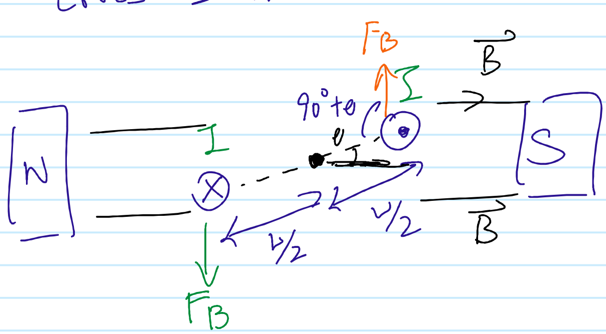
1. coil
2. Magnet
3. Commutator
4. Power Source.

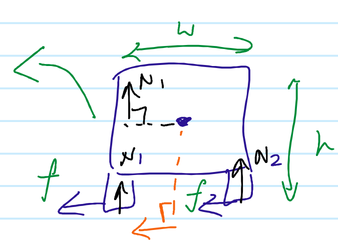
For AC:

↓

- Electro magnet set up by the same ac current

Cross section





ACW :
$$\tau = \left(F_B \cdot \sin(90°+\theta)\, \tfrac{w}{\cancel{2}}\right) \cancel{2}$$
$$= BIl\, w \sin(90°+\theta)$$
$$= BIA \cos\theta$$

Multiple turns.

$$\tau_N = NBAI \cos\theta.$$

τ largest when $\theta = 0°$ (horizontal position)

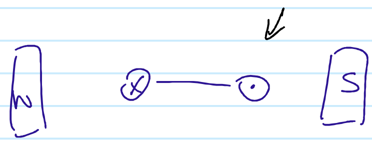
CW : $(\Sigma f \cdot)\frac{h}{2} + N_1 \frac{w}{2}$

ACW = $\frac{N}{2} \cdot \frac{w}{2}$

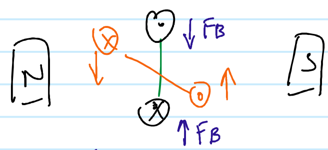
$$\frac{mv^2}{r}\frac{h}{\cancel{2}} + N_1\frac{w}{\cancel{2}} = \frac{wN_2}{\cancel{2}}$$

$$N_1 + N_2 = mg$$

τ largest when $\theta = 0^\circ$ (horizontal position)



$\tau = 0 \quad \theta = 90^\circ$



$F \parallel r \Rightarrow$ No τ

Commutator

When the coil passes the vertical position,
it reverses the polarity of the coil (reverse direction of current)

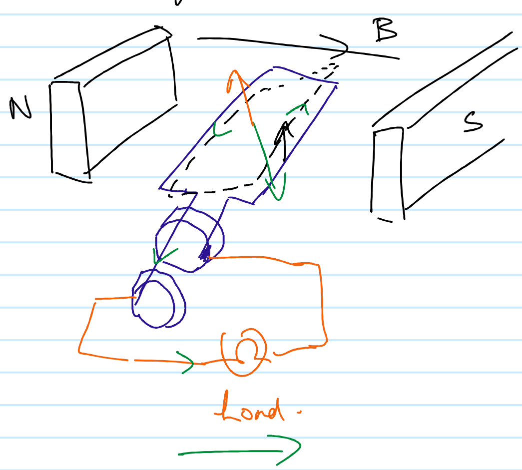
So the coil can continuously rotate.

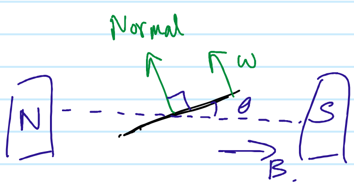
Why can the coil pass vertical position:

By inertia of rotation.

Generator : (−1) . Motor.

AC : Slip rings DC : Commutator.





$$\Phi = \int \vec{B} \cdot d\vec{A}$$

$= NBA \cos\varphi \qquad \varphi$: $\angle$ between $\vec{B}$ and normal

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$= NBA\cos(90^\circ+\theta)$

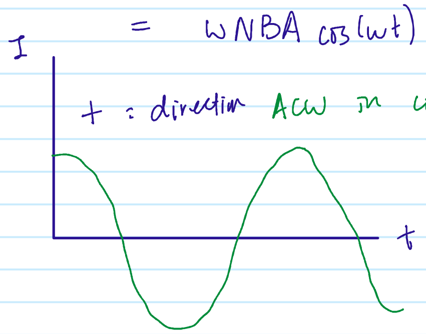
$= -NBA\sin\theta$

$= -NBA\sin\left(\frac{2\pi}{T}t\right) = -NBA\sin(\omega t)$

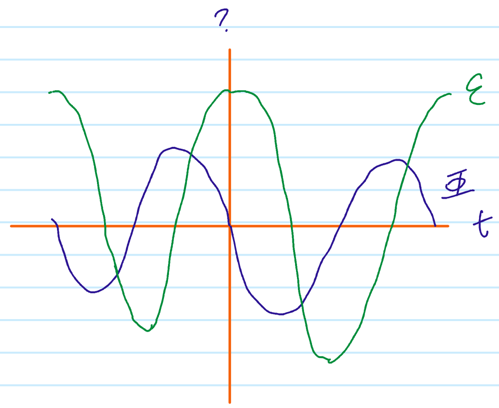
$(\omega = 2\pi f)$

$\varepsilon = -\frac{d\phi}{dt}$

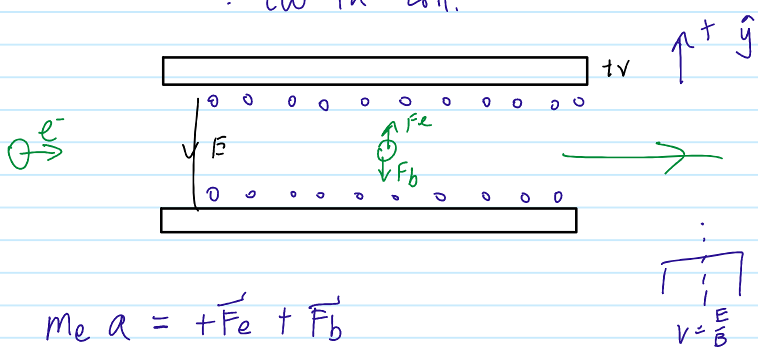
$= \omega NBA\cos(\omega t)$. $/\cos(\theta)$



− : CW in coil.



$\varepsilon = -\frac{d\Phi}{dt}$



$m_e a = +\vec{F_e} + \vec{F_b}$

$m_e a = q(\vec{E} + \vec{v}\times\vec{B})$

$m_e a\,\hat{y} = |e|(E\hat{y} - v_x B\hat{y})$

$\vec{a} = \frac{|e|(E - v_x B)}{m_e}\hat{y}$

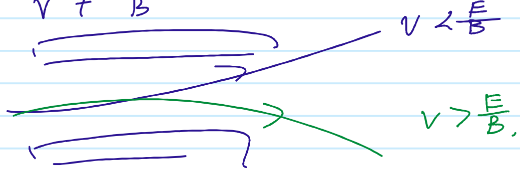
for $\vec{a} = 0$

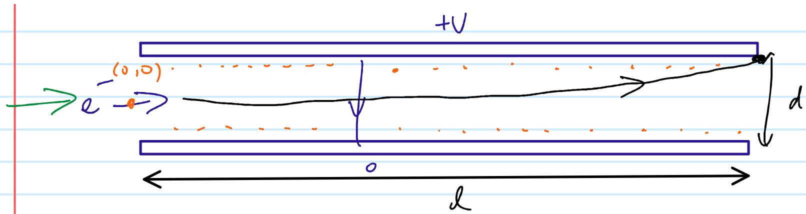
① $q = 0$ (trivial)

② $E - vB = 0$

$v_x = \frac{E}{B}$ ☆

If $v \neq \frac{E}{B}$





$$a = \frac{|e|(E - v_x B)}{m_e}\hat{y}$$

$$S_y = \cancel{v_y}^{0} t + \frac{1}{2} a t^2$$

$$S_x = l$$

$$v_x = V_x$$

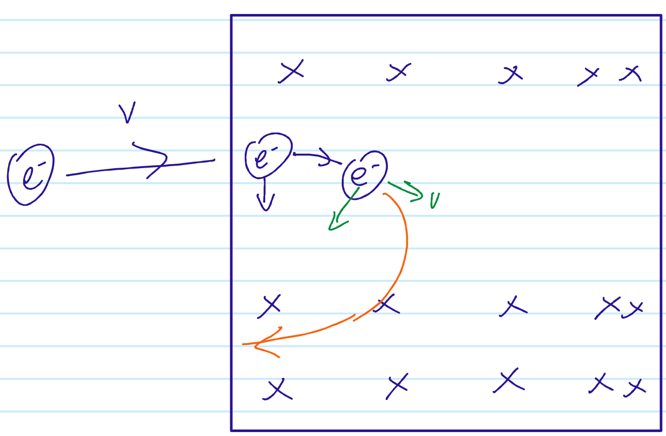
$$\Delta t = \frac{l}{v_x}$$

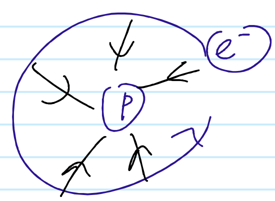
$$S_y = \frac{d}{\cancel{2}} = \cancel{\frac{1}{2}} \frac{|e|(E - v_x B)}{m_e}\left(\frac{l}{v_x}\right)^2$$

$$v_x^2 \, d/l^2 = \frac{|e|E}{m_e} - \frac{|e|B}{m_e} v_x$$

$$(\pm)\frac{d}{l^2} v_x^2 + \frac{|e|B}{m_e} v_x - \frac{|e|E}{m_e} = 0$$

$$v_x = \frac{2l^2}{d}\left[-\frac{|e|B}{m_e} + \sqrt{\left(\frac{|e|B}{m_e}\right)^2 + 4\frac{d}{l^2}\frac{|e|E}{m_e}}\right]$$





$$\frac{mv^{\cancel{2}}}{r} = q\cancel{v}B$$

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

$+1.602\cdot10^{-19} \rightarrow$ $\frac{q}{m} = \frac{v}{Br}$ ← can be measured.

Change in v ?

Change in v?

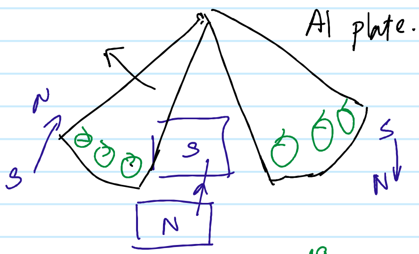
$$W = \int \vec{F} \cdot \vec{ds} \qquad \vec{F_B} \perp \vec{v}$$

$$= \int \underbrace{(\vec{v} \times \vec{B}) \cdot \vec{v}}_{0} \, dt \qquad \therefore \vec{F_B} \perp \vec{ds}$$

$$= 0$$

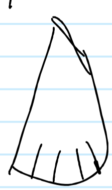
No change in v.

Eddy current



$F \propto -\frac{d\theta}{dt}$ F opposes ω.

Reduce eddy: laminate



↳ decrease area for eddy currents.