FORÇA MAGNÉTICA ENTRE CABOS PARALELOS COM CORRENTE

Dois cabos com correntes I_1 e I_2, com comprimento ℓ, distanciados d. $\Rightarrow I_1 \to \vec{B}_1 \to \vec{F}_{12} = (\vec{I}_2 \times \vec{B}_1)\,\ell$

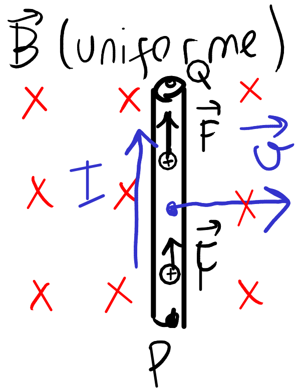
$$\boxed{F_{12} = \frac{2k_m I_1 I_2 \ell}{d}}$$

Dois Casos

correntes no mesmo sentido
força atrativa

correntes em sentidos opostos
força repulsiva

INDUÇÃO ELETROMAGNÉTICA

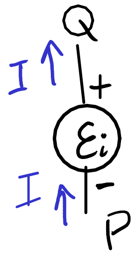


$$\vec{F} = q(\vec{v} \times \vec{B})$$

$$\text{f.e.m. induzida} = \mathcal{E}_i = \frac{\int_P^Q \vec{F} \cdot d\vec{r}}{q}$$

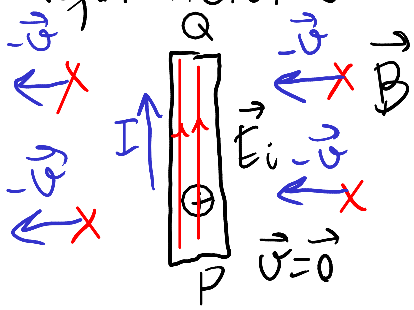
$$\mathcal{E}_i = |\vec{v} \times \vec{B}| \int_P^Q ds = vB\ell$$ ← distância $\overline{PQ}$

circuito



$$\vec{E}_i = \vec{0}$$

Referencial em movimento com o condutor



$$\vec{F}_m = \vec{0}$$

campo elétrico $\vec{E}_i$ (induzido) devido à variação de $\vec{B}$

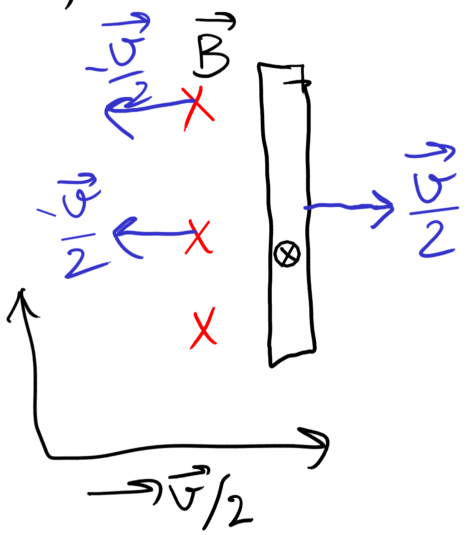
campo eletromagnético $(\vec{E}, \vec{B})$

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

$$\boxed{\vec{E}_i = \vec{v} \times \vec{B}}$$

$$\mathcal{E}_i = \int_P^Q \vec{E}_i \cdot d\vec{r}$$

Referencial com velocidade $\frac{\vec{v}}{2}$



$\vec{B}$, $\vec{E}_i = \frac{1}{2}(\vec{v} \times \vec{B})$

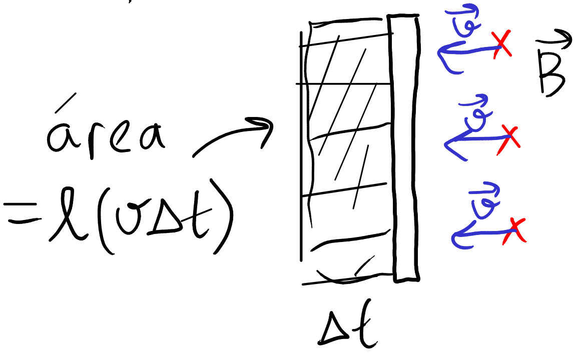
$$\vec{F} = \frac{q}{2}(\vec{v} \times \vec{B}) + \frac{q}{2}(\vec{v} \times \vec{B})$$

$\uparrow$ $q\vec{E}_i$

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

Fluxo magnético: $\Psi_S = \iint_S (\vec{B} \cdot \hat{n})\, dA$

referencial em mov. com o condutor



$$\Delta\Psi_S = l v \Delta t B$$

$$\mathcal{E}_i = \frac{\Delta\Psi_S}{\Delta t}$$

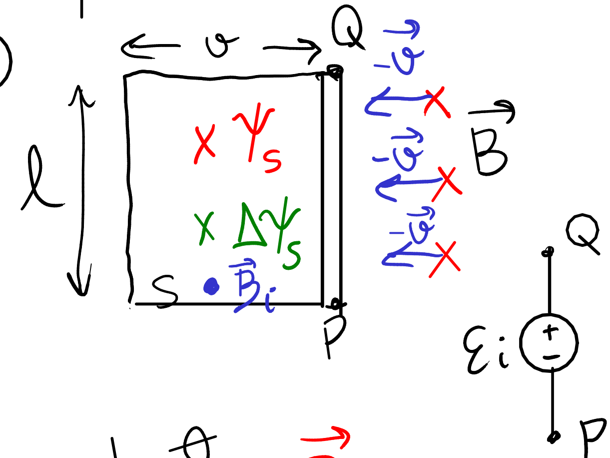
LEI DE FARADAY

$$\boxed{\mathcal{E}_i = -\frac{d\Psi_S}{dt}}$$

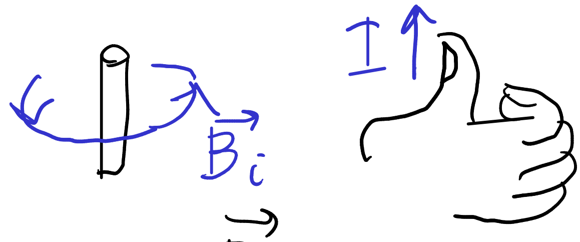
Lei de Lenz: quando existir variação de ψ_S, a f.e.m. induzida produz corrente induzida que contraria essa variação de ψ_S

Exemplos:

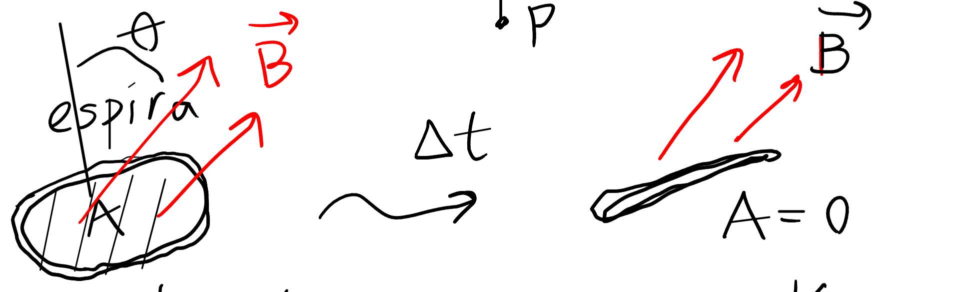
(1)



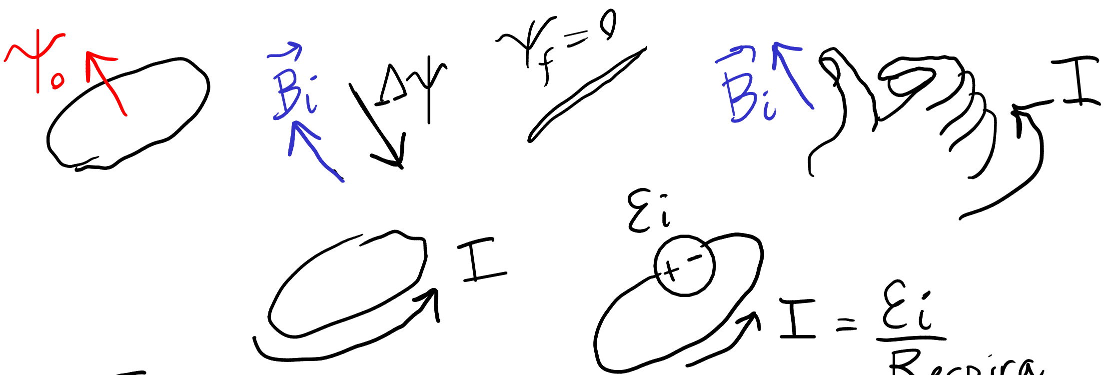
$\vec{B}_i$ = campo devido à corrente induzida



(2)



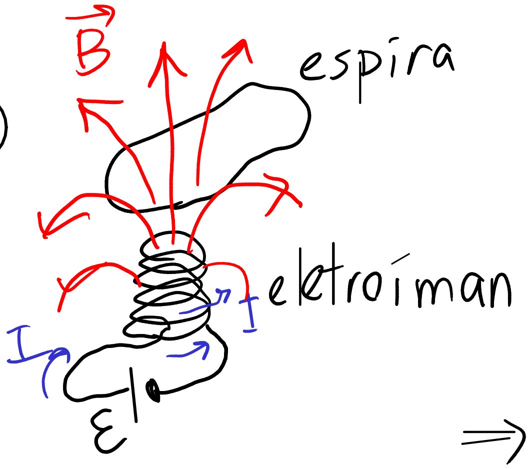
$\psi_0 = BA\cos\theta$ $\qquad$ $\psi_f = 0$ $\qquad$ $\Delta\psi = -\psi_0$



$$I = \frac{\mathcal{E}_i}{R_{espira}}$$

$$\mathcal{E}_i = \frac{-BA\cos\theta}{\Delta t}$$

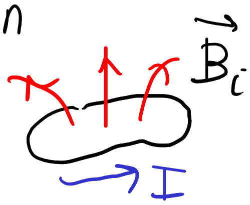
③



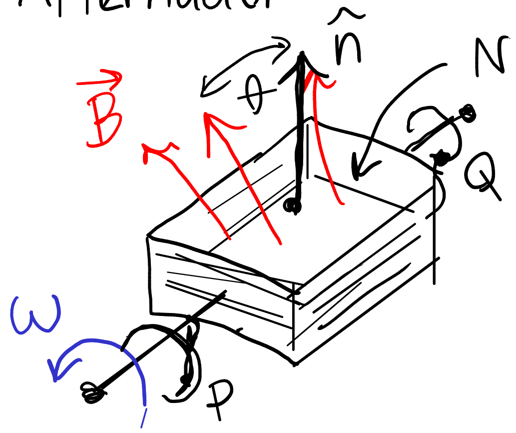
$\uparrow \Psi$

desliga-se a fonte do eletroíman

$\Rightarrow \downarrow \Delta\Psi \quad \uparrow \vec{B}_i$



④ Alternador



N espiras de área A

$$\Psi_{bobina} = N \iint_{espira} (\vec{B}\cdot\hat{n})\, dA$$

$$= (N \bar{B} \cos\bar{\theta}) A$$

constante

$$\mathcal{E}_i = -\frac{d\Psi_{bobina}}{dt} = -N\bar{B}A \frac{d}{dt}(\cos\bar{\theta})$$

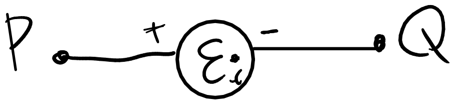
$$= (N\bar{B}A \sin\theta)\frac{d\theta}{dt}$$

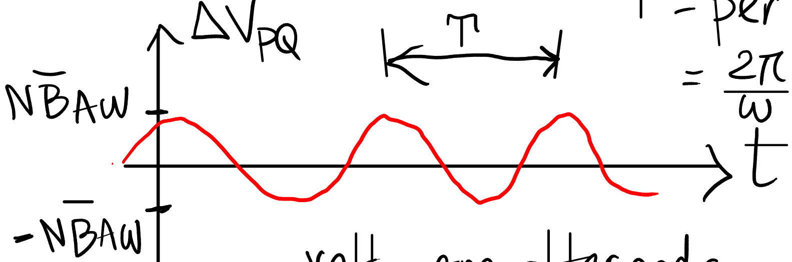
$$\boxed{\mathcal{E}_i = N\bar{B}A\omega \sin(\omega t + \theta_0)}$$

(se ω = constante)

T = período $= \frac{2\pi}{\omega}$

$\Delta V_{PQ} = \mathcal{E}_i$





voltagem alternada.

$f = \frac{\omega}{2\pi}$ (frequência)