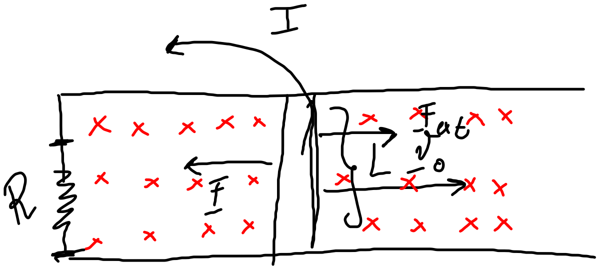
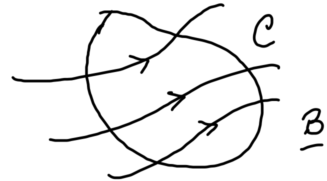
$$f.e.m. = -\frac{d\Phi_S(\underline{B})}{dt}$$





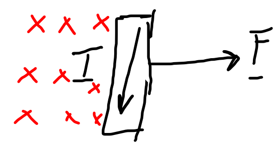
$$fem = B L v_0 \qquad I = \frac{fem}{R} = \frac{B L v_0}{R}$$

Sulla sbarretta agisce la forza $\underline{F} = I\,\underline{L} \times \underline{B}$ e' frenante

$$|\underline{F}| = I L B = \frac{B^2 L^2 v_0}{R}.$$

$$Potenza = F \cdot v_0 = \frac{B^2 L^2 v_0^2}{R} = \frac{(fem)^2}{R}$$ → Potenza dissipata sulla resistenza per effetto Joule

Suppongo, per assurdo, che $\underline{I}$ scorra in senso orario

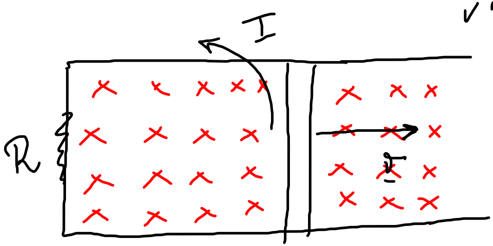


La sbarretta viene accelerata "gratuitamente": v aumenta

fem aumenta ($\propto v$)

$I = \frac{fem}{R}$ aumenta

Conservazione energia violata $\Leftarrow$ $P_R = \frac{(fem)^2}{R} \propto v^2$ aumenta



$v(0) = v_0$ lascio evolvere il sistema

$fem = BLv(t)$ $\qquad I = \frac{fem}{R} = \frac{BLv(t)}{R}$

$\underline{F} = I\,\underline{L} \times \underline{B}$ $\qquad |\underline{F}| = \frac{L^2B^2 v(t)}{R}$ $\qquad F = -\frac{L^2B^2 v(t)}{R} = m\frac{dv}{dt}$

$$\frac{dv}{dt} = -\frac{L^2B^2}{mR} v \qquad \gamma = \frac{L^2B^2}{mR}$$

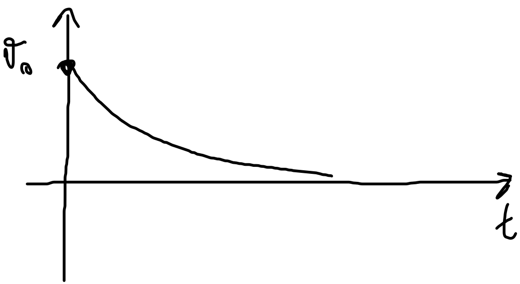
Forza di tipo viscoso

$$\frac{dv}{dt} = -\gamma v$$

eq. differenziale per $v(t)$ a variabili separabili

$$\int_{v_0}^{v(t)} \frac{dv}{v} = -\gamma \int_0^t dt \qquad \ln v \Big|_{v_0}^{v(t)} = -\gamma t; \quad \ln v(t) - \ln v_0 = -\gamma t$$

$$\ln \frac{v(t)}{v_0} = -\gamma t; \quad v(t) = v_0 e^{-\gamma t}$$



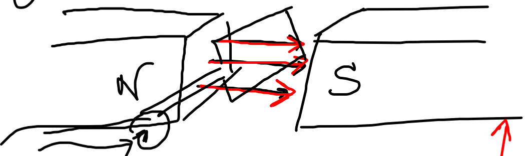
$$\gamma \overset{def}{=} 1/\tau; \quad \tau \overset{def}{=} \frac{1}{\gamma} = \frac{mR}{L^2 B^2}$$

Se $t = 5\tau$, allora $\frac{v(5\tau)}{v_0} = e^{-5} \simeq 0.7\%$

$\tau \propto R, m$

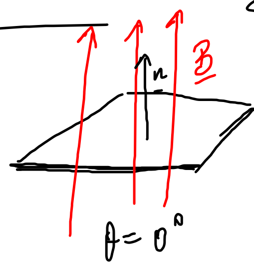
$\tau \propto \frac{1}{L^2}, \frac{1}{B^2}$

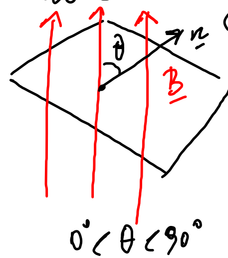
Generatore di tensione alternata

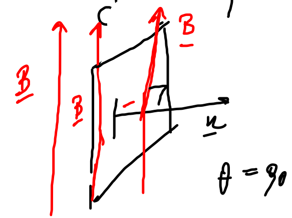


Spira in rotazione con $\omega = \text{cost}$

Si produce una fem lungo la spira







$$\underline{B} \cdot d\underline{S} = B\, dS \cos\theta \qquad \theta = \omega t$$

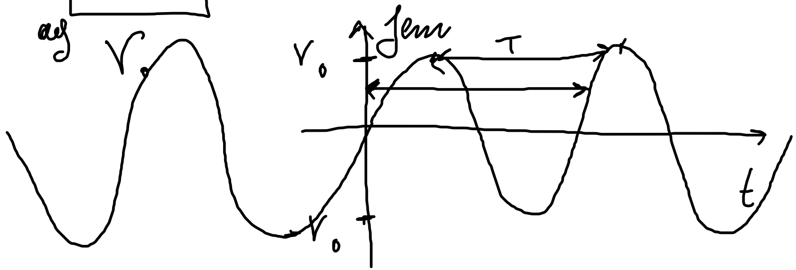
$$= B\, dS \cos(\omega t)$$

$$\Phi(\underline{B}) = \int \underline{B} \cdot d\underline{S}$$

$$= \int_{spira} B\, dS \cos(\omega t) = B\cos(\omega t) \int_{spira} dS = B A_{spira} \cos(\omega t)$$

$$f_{em} = -\frac{d\Phi}{dt} = B A_{spira}\, \omega \sin(\omega t)$$

$$\mathcal{E}_{em} = \underbrace{B A_{sp}\, \omega}_{V_0} \sin(\omega t) = V_0 \sin(\omega t)$$

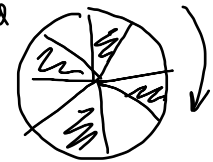


$$T = \frac{2\pi}{\omega} \qquad \nu = \frac{1}{T} = \frac{\omega}{2\pi}$$

$\nu = 50\ Hz$ standard EU

$\nu = 60\ Hz$ // USA

$$P = \frac{(\mathcal{E}_{em})^2}{R} = \frac{V_0^2}{R}\sin^2(\omega t) \quad \text{Pot. istantanea}$$



$t = 0 \Rightarrow y = 0$

$t = 2\pi/\omega \Rightarrow y = 2\pi$

$y \overset{def}{=} \omega t \qquad dt = \frac{1}{\omega}\, dy$

$$\langle P \rangle = \frac{\int_0^T \frac{V_0^2}{R}\sin^2(\omega t)\, dt}{T} = \frac{V_0^2}{R} \cdot \frac{\omega}{2\pi} \int_0^{2\pi/\omega} \sin^2(\underbrace{\omega t}_{})\, dt = \frac{V_0^2}{R}\frac{\cancel{\omega}}{2\pi}\frac{1}{\cancel{\omega}}\int_0^{2\pi} dy\, \sin^2 y$$

T

TRUCCO

$$\cos(2y) = \cos^2 y - \sin^2 y = \underbrace{1-\sin^2 y}_{\cos^2 y} - \sin^2 y = 1 - 2\sin^2 y \Rightarrow \sin^2 y = \frac{1-\cos(2y)}{2}$$

$$\langle P\rangle = \frac{V_0^2}{2\pi R}\int_0^{2\pi}\left(\frac{1}{2} - \frac{\cos(2y)}{2}\right)dy = \frac{V_0^2}{2\pi R}\left[\frac{1}{\cancel{2}}\cdot\cancel{2}\pi - \cancel{\frac{1}{2}\underbrace{\int_0^{2\pi}\cos(2y)\,dy}_{\frac{1}{2}\sin(2y)\big|_0^{2\pi}}}\right] = \frac{V_0^2}{2\cancel{\pi}R}\cdot\cancel{\pi} = \frac{V_0^2}{2R}$$

$$f_{em} = V_0 \sin(\omega t)$$

$$\langle P\rangle = \frac{V_0^2}{2R} = \frac{1}{2}\cdot P_{max} \qquad V_{eff} \overset{def}{=} V_0/\sqrt{2}$$

$$\langle P\rangle = V_{eff}^2/R$$

$V_{eff} = 220\,V$ EU

$V_{eff} = 120\,V$ USA

Alternatore