GABARITO - 3^a PROVA

FISICA 3 - Escola Politécnica - 2000

FGE 2295 - 27/6/2000

Questão 1

a) $\vec{v} = v\,\hat{e}_x\,; \quad \vec{B} = B(-\,\hat{e}_y)$

$\vec{F}_L = -e\,\vec{v}\times\vec{B} = e\,v\,B\,\hat{e}_z \rightarrow I$ é para baixo $\rightarrow$ SENTIDO HORÁRIO

b) $\Phi_m = B\cdot\ell\cdot x(t) \rightarrow \varepsilon = -\frac{d\Phi_m}{dt} = -\,B\,\ell\,v$

$I = \frac{|\varepsilon|}{R} = \frac{B\,\ell\,v}{R}$

c) BALANÇO DE ENERGIA: POTÊNCIA APLICADA = POTÊNCIA DISSIPADA

$P_{\text{ap}} = F\,v = \varepsilon^2/R = (B\,\ell\,v)^2/R$

$\vec{F} = \frac{(B\ell)^2 v}{R}\,\hat{e}_x$

Questão 2

a) $M = (N)\frac{\Phi_m}{I} = (N)C$

b) $\varepsilon = -\frac{d}{dt}((N)\Phi_m) \;-\; \frac{d}{dt}[M\,I_o\,\text{sen}\,(\omega t)] = -(N)C\,\omega\,I_o\,\cos(\omega t)$

$P = \varepsilon^2/R = [(N)C\,\omega\,I_o\,\cos(\omega t)]^2/R$

c) $d\Phi_m = B(r)dA = B(r)\cdot\ell dr = \frac{\mu_o I(t)}{2\pi r}\,dr\cdot\ell$

$\Phi_m = \frac{\mu_o}{2\pi}\cdot\ell\,I(t)\int_h^{h+w}\frac{dr}{r} = \frac{\mu_o}{2\pi}\,\ell\,I(t)\,\ell n(\frac{h+w}{h}) = \frac{C\cdot I(t)}{(N)}$

$C = (N)\,\frac{\mu_o\,\ell}{2\pi}\,\ell n\,(\frac{h+w}{h})$

Questão 3

a) Fluxo em 1: $B_1 = \kappa_m\,N_1 I_1/\ell_1 \Rightarrow \Phi_1 = \kappa_m\,\frac{N_1 I_1}{\ell_1}\cdot A$

$L = N_1\Phi_1/I_1 \Rightarrow L = \kappa_m\,N_1^2\,A/\ell_1$

b) $M = N_2\,\Phi_{21}/I_1 \Rightarrow M = \kappa_m\,\frac{N_1 N_2}{\ell_1}\cdot A$

Questão 4

a) $L\,\frac{dI}{dt} + \frac{Q}{c} \;=\; 0$ (Kirchhoff)
$\Rightarrow L\,\frac{d^2I}{dt^2} \;+\; \frac{I}{C} \;=\; 0$

b) Solução da eq. diferencial:

$$\begin{aligned} I(t) &= I_m \,\text{sen}\,(\omega t + \delta) \quad \text{com } \omega = \frac{1}{\sqrt{LC}} \\ \rightarrow Q(t) &= Q_m \,\cos\,(\omega t + \delta) \end{aligned}$$

$Q(t=0) \;=\; Q_m \Rightarrow \delta = 0 \Rightarrow Q(t) \;=\; \cos(\omega t)$
$\Rightarrow I(t) \;=\; -\,\omega\, Q_m\, \text{sen}(\omega t) \Rightarrow I_m \;=\; \omega\, Q_m$

c) $U(t) \;=\; \frac{1}{2}\,\frac{Q^2}{C} \;+\; \frac{1}{2}\,LI^2 = \frac{1}{2}\,\frac{Q_m^2}{C}\,\cos^2(\omega t) + \frac{1}{2}L(\omega^2 Q_m^2)\text{sen}^2(\omega t)$

$$\begin{aligned} \omega^2 \;=\; \frac{1}{LC} \Rightarrow U(t) &= \frac{1}{2}\left[\frac{Q_m^2}{C}\,\cos^2(\omega t) \;+\; L\,\frac{Q_m^2}{LC}\,\text{sen}^2(\omega t)\right] \\ &= \frac{1}{2}\,\frac{Q_m^2}{C}[\cos^2(\omega t) \;+\; \text{sen}^2(\omega t)] \;=\; \frac{1}{2}\,\frac{Q_m^2}{C} \;=\; cste. \end{aligned}$$

OU

$U(t) \;=\; \frac{1}{2}\,\frac{Q^2}{C} \;+\; \frac{1}{2}LI^2 \;\Rightarrow\; \frac{dU}{dt} \;=\; \frac{Q}{C}\,\frac{dQ}{dt} \;+\; LI\,\frac{dI}{dt} \;=\; I(\frac{Q}{C} + L\,\frac{dI}{dt})$ em (a) vimos que $\frac{Q}{C} \;+\; L\,\frac{dI}{dt} = 0 \Rightarrow \frac{dU}{dt} = 0$