Parcial Física 3 - 04/12/14

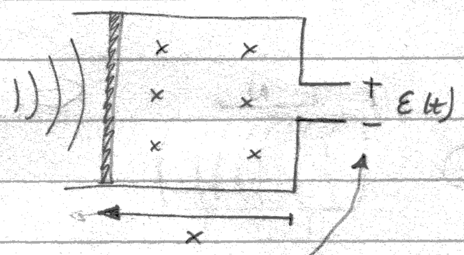
① $-\frac{d\phi_B}{dt} = \mathcal{E}(t)$

ⓐ

$$\phi_B = B_{ext}\, a\, x$$

$$\left|\frac{d\phi_B}{dt}\right| = B_{ext}\, a\, \dot{x} = \mathcal{E}(t) = V_m \cos(\omega t)$$

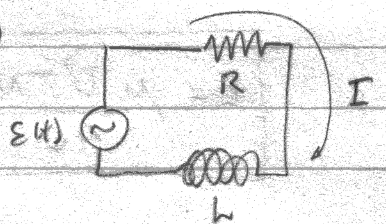
$$\dot{x} = +\frac{V_m}{B_{ext}\, a} \cos(\omega t)$$



$$\boxed{\Delta x(t) = \frac{+V_m}{B_{ext}\, a\, \omega} \operatorname{sen}(\omega t)}$$

El signo + para esta elección de polaridad

ⓑ



$$V_L = L\frac{dI}{dt} = i L \omega I_m$$

$$L\frac{dI}{dt} + RI = \mathcal{E}$$

$$I(t) = I_m e^{i\omega t}$$

$$I_m = |I_m| e^{i\varphi}$$

$$i\omega L\, I_m + R\, I_m = V_m$$

$$I_m = \frac{V_m}{R + i\omega L}$$

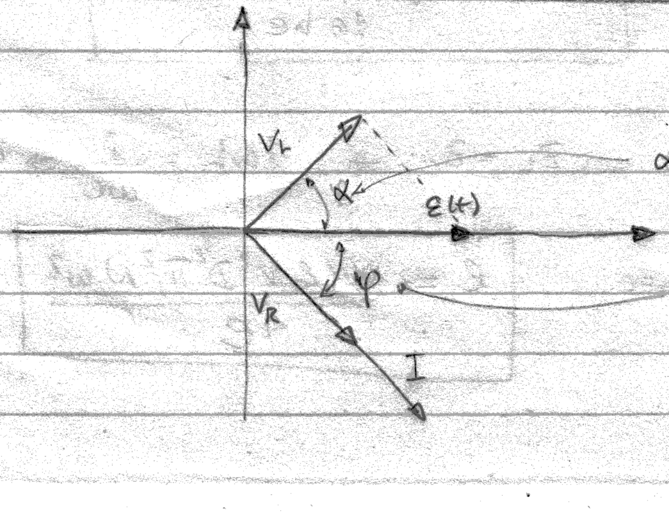
$$\mathcal{E} = V_m e^{i\omega t}$$

$$V_L = \frac{i L \omega\, V_m}{R + i\omega L} = \frac{V_m L \omega}{\omega L - iR}$$

$$\boxed{V_L = \frac{V_m L \omega}{\sqrt{R^2 + L^2\omega^2}} \cos\left(\omega t + \operatorname{Arctg}\left(R/L\omega\right)\right)}$$

ⓒ

En un referencial girando a la vel. angular ω



$\alpha = \operatorname{Arctg}(R/L\omega)$

$\varphi = -\operatorname{Arctg}\left(\frac{\omega L}{R}\right)$

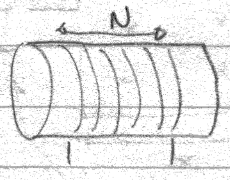
(d) $\overline{P_L} = \emptyset$; $\overline{P_R} = \frac{1}{2} V_{Rm} I_m \cos(\varphi_R)$ $\cdot\ \varphi_R = \emptyset$

$$V_{Rm} = \frac{R V_m}{\sqrt{R^2 + \omega^2 L^2}} \quad ; \quad I_m = \frac{V_m}{\sqrt{R^2 + \omega^2 L^2}}$$

$$\overline{P_R} = \frac{R V_m^2}{2 (R^2 + \omega^2 L^2)}$$

(2)

(a)



$B = \mu I \eta$; η : densidad de espiras (espiras/metro)

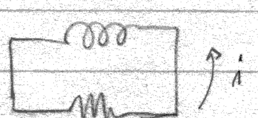
$\eta = 1/e$

$$\phi_B = N B \left(\frac{D}{2}\right)^2 \pi = \mu I \frac{1}{e} \frac{D^2}{4} \pi N$$

$$\left|\frac{d\phi_B}{dt}\right| = \Delta\mathcal{E}_L \Rightarrow \Delta\mathcal{E}_L = \frac{\mu D^2 \pi N}{4e} \frac{dI}{dt} \qquad \boxed{L = \frac{\mu D^2 \pi N}{4e}}$$

$$R = \frac{h}{\sigma S} = \frac{4h}{\pi d^2 \sigma}$$

$$S = \left(\frac{d}{2}\right)^2 \pi$$



$$i = i_0 e^{-R/L\, t} \Rightarrow e^{-R/L\, t} = 0{,}1$$

$$t = -\frac{L}{R} \ln(0{,}1)$$

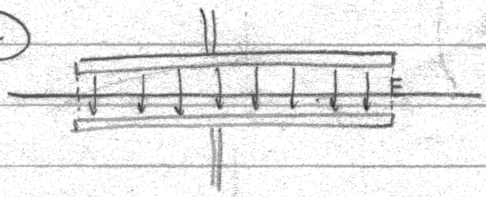
$$t = \frac{L}{R} \ln(10)$$

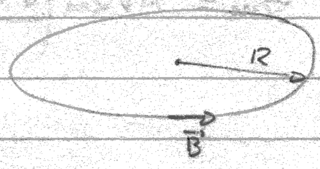
$$\boxed{t = \ln(10) \frac{\mu D^2 \pi^2 N d^2 \sigma}{16 h e}}$$

(b) $C = \frac{\varepsilon_0 r^2 \pi}{\ell}$ $\qquad Z_L = Z_C \Rightarrow i\omega L = \frac{i}{\omega C} \Rightarrow \omega^2 = \frac{1}{LC}$

$$\omega^2 = \frac{1}{\frac{\mu D^2 \pi N}{4e} \cdot \frac{\varepsilon_0 r^2 \pi}{\ell}} \Rightarrow \boxed{\ell = \frac{\mu \varepsilon_0 r^2 D^2 \pi^2 N \omega^2}{4e}}$$

(c)





$$\oint \vec B\, d\vec \ell = B_\varphi\, 2\pi R = \mu_0 \varepsilon_0 \frac{d\phi_E}{dt} = \mu_0 \varepsilon_0 \frac{\dot V_c\, r^2 \pi}{\ell}$$

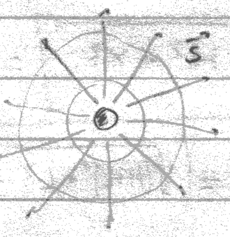
$|\vec E| = \frac{V_c}{\ell}$ $\qquad \phi_E = \frac{V_c}{\ell} \cdot r^2 \pi$

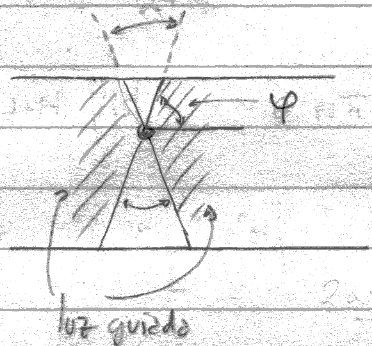
$$\frac{d\phi_E}{dt} = \frac{\dot V_c}{\ell} r^2 \pi$$

$$\boxed{B_\varphi = \frac{\mu_0 \varepsilon_0 r^2 \dot V_c}{2 R \ell}}$$

(3)

(a)

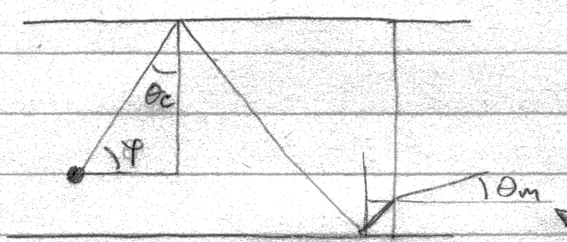




$$\frac{4\varphi}{2\pi} = 0{,}8$$

$\varphi = 0{,}4\pi$

↑ φ_{max} de emisión



$n(\lambda)\, \text{sen}\, \theta_c = 1$

$n(\lambda)\, \text{sen}(\pi/2 - \varphi_m) = 1$

$n(\lambda) \cos \varphi_m = 1$

ángulo máximo φ ($\varphi\uparrow \Rightarrow \cos\varphi \downarrow$)

$$n(\lambda)_{max} = \frac{1}{\cos \varphi_m} = \frac{1}{\cos(0{,}4\pi)}$$

$$n_0 + m_1 \lambda_e > \frac{1}{\cos(0{,}4\pi)}$$

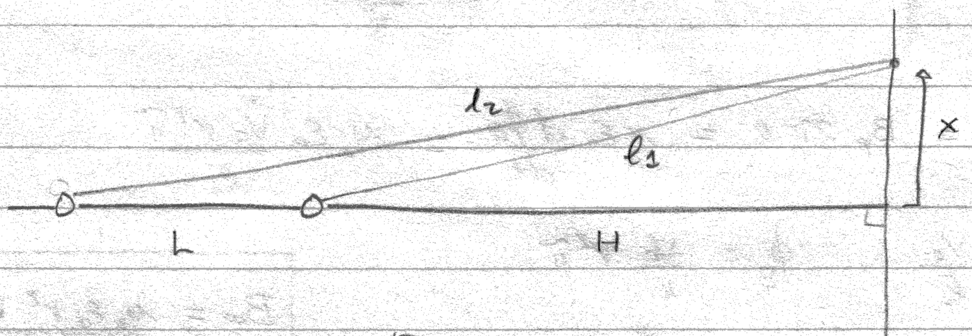
$$\boxed{\lambda_e > \left[\frac{1}{\cos(0{,}4\pi)} - n_0\right] \frac{1}{m_1}} \qquad (m_1 > 0)$$

(b) $n_s\, \text{sen}\, \theta_m = n\, \text{sen}(\pi/2 - \theta_c) = n \cos \theta_c$

$$\operatorname{sen}\theta_m = \frac{n}{n_s}\sqrt{1-\frac{1}{n^2}} = \frac{\sqrt{n^2-1}}{n_s}.$$

$$\theta \leq \theta_m = \operatorname{Arcsen}\left(\frac{\sqrt{n^2-1}}{n_s}\right)$$

(c)



$$l_1 = \sqrt{H^2+x^2} \quad ; \quad l_2 = \sqrt{(H+L)^2+x^2}$$

$$k\,\Delta l = 2\pi n \qquad n = 0, \pm 1, \pm 2, \ldots$$

$$k(l_2-l_1) = 2\pi n \qquad k\left[\sqrt{(H+L)^2+x^2}-\sqrt{H^2+x^2}\right] = 2\pi n$$

$$\frac{2\pi}{\lambda}\left[\sqrt{(H+L)^2+L^2}-\sqrt{H^2+L^2}\right] = 2\pi \Rightarrow \qquad \boxed{\lambda = \left(\sqrt{(H+L)^2+L^2}-\sqrt{H^2+L^2}\right)}$$