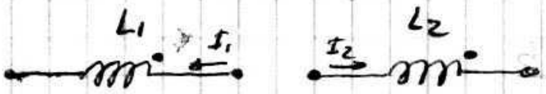
LENTINI PEDRO

20/05/2011

PROBLEMA 5.1



$L_1 = 32\,mH$ $\quad L_2 = 8\,mH$ $\quad I_1 = 2A$ $\quad N_1 = 1000$

$k = 0,9$ $\quad I_2 = 1A$ $\quad N_2 = 500$

$$k = \frac{\phi_{21}}{\phi_{1p}} = \frac{\phi_{12}}{\phi_{2p}}$$

Coef de acoplamiento

$$\boxed{k = \frac{M}{\sqrt{L_1 . L_2}}} \qquad M = k . \sqrt{L_1 . L_2} \qquad M = 0,9 . \sqrt{32mH . 8mH}$$

$$M = 14,4\,mH$$

$$M = \frac{N_1 . \phi_{12}}{I_2} \qquad M = \frac{N_2 . \phi_{21}}{I_1}$$

$$\boxed{\phi_{12} = \frac{M . I_2}{N_1}} \qquad \boxed{\phi_{21} = \frac{M I_1}{N_2}} \qquad \phi_{12} = 14,4\,\mu Wb$$

$$\phi_{21} = 57,6\,\mu Wb$$

$$\lambda_1 = L_1 . I_1 - M I_2 = N_1 (\phi_{1d} + \phi_{21} + \phi_{12})$$

$$\lambda_2 = L_2 . I_2 - M I_1 = N_2 (\phi_{2d} + \phi_{12} + \phi_{21})$$

$$\lambda_1 = 32\,mH \cdot 2A - 14,4\,mH \cdot 1A = 49,6\,mWb$$

$$\lambda_2 = 8\,mH . 1A - 14,4\,mH \cdot 2A = -20,8\,mWb$$

$$\phi_{1p} = \frac{\phi_{21}}{k} = 64\,\mu Wb$$

$$\phi_{2p} = \frac{\phi_{12}}{k} = 16\,\mu Wb$$

$$\lambda_{1p} = 64\,mWb = N_1 \phi_{1p}$$

$$\lambda_{2p} = N_2 \phi_{2p} = 8\,mWb$$

PROBLEMA 5.2

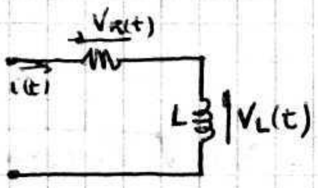
$$\lambda = N\phi = L i$$

$N = 100 \qquad i = 2A \qquad \phi = 0{,}75 \text{ Wb}$

$$L = \frac{N\phi}{i} = \frac{100 \cdot 0{,}75 \text{ Wb}}{2A}$$

$$\boxed{L = 37{,}5 \text{ H}}$$

PROBLEMA 5.3



$R = 32\,\Omega$

$L = 1\text{H}$

1) $V(t) = V_L(t) + V_R(t)$

$$V(t) = L\frac{di}{dt} + i(t) \cdot R$$

2) $\lambda = i(t) \cdot L$

$$\phi = \frac{\lambda}{N}$$

3) $$E_R = \int_{t_0}^{t_f} P_R(t)\,dt$$

$$E_R = \int_{t_i}^{t_f} R\, i^2(t)\,dt$$

$$E_L = \int_{t_0}^{t_f} V_L(t) \cdot i(t)\,dt$$

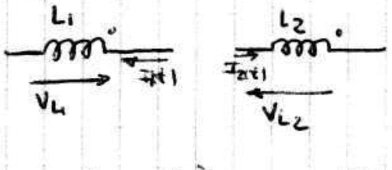
$$E_L = \int_{t_0}^{t_f} \phi \frac{di(t)}{dt} \cdot i(t)\,dt$$

$$\frac{d(i^2(t))}{dt} = 2i(t) \cdot \frac{di(t)}{dt}$$

$$i(t)\frac{di\,t}{dt} = \frac{1}{2}\frac{d\,i^2(t)}{dt}$$

$$\boxed{E_L = \frac{L}{2} i^2(t)}$$

PROBLEMA 5.4



$$V_{L_1}(t) = L_1\frac{di}{dt} - M\frac{di_2}{dt} \qquad V_{L_2}(t) = L_2\frac{di_2}{dt}$$

LENTINI PEDRO

PROBLEMA 5.5

bobina → $N, a, b, \omega_M = \frac{\pi . n}{30}$

$\alpha = \omega t - \delta e$

$\lambda = N \phi$

$\phi = \vec{B} \cdot \vec{A} = B . A \cos \alpha$

a) $e(t) = \frac{d(\lambda)}{dt} = - \frac{d(NBA\cos(\omega t + \delta e))}{dt}$

$$\boxed{e(t) = \omega NBA \operatorname{sen}(\omega t + \delta e)}$$

b) $\omega = \frac{p}{2} \omega_M$

$p = 2 \qquad \boxed{\omega = \omega_M}$

PROBLEMA 5.6

1) $E_{max} = 311,13 \text{ V} \qquad n = 3000 \text{ rpm}$

$\omega = 100\pi \leftarrow \omega = \frac{\pi . 3.000}{30} \qquad B = 6000 \text{ G} = 0,6 \text{T}$

$\frac{p}{2}$ $0,6\text{T} \; 100\pi \; A . N = 311,10 \text{ V}$

$\underbrace{\left(\frac{p}{2}\right)}_{1} A . N = 1,65 \text{ m}^2$

$e(t) = \underbrace{\omega N . a . b \; B}_{E_{max}} \operatorname{sen}(\omega t + \delta_e)$

2) $n = 1500 \text{ rpm} \qquad \Theta_M \to \Theta_e \qquad E_{max} = \frac{p}{2} \omega N a . b . B .$

$$\boxed{311,13 \text{V} = \frac{p}{2} 100\pi . N \, a . b \; 0,6\text{T}}$$

$\omega = \frac{\pi . 1500}{30} = 50\pi$

$A . N . = \frac{311.10 \text{V}}{50\pi \; 0,6\text{T}}$

PROBLEMA 5.8

$\overline{\text{mm}}_{10\Omega}$

$N = 100$ $S = 0{,}001\,m^2$

$$\frac{dq}{dt} = \frac{e(t)}{R}$$

$$e(t) = -\frac{d\lambda}{dt}$$

$$e(t) = -N\frac{d\phi}{dt}$$

$$\frac{dq}{dt} = -\frac{N}{R}\frac{d\phi}{dt}$$

$$dq = -\frac{N}{R}\,d\phi$$

$$\int_{q_0}^{q_f} dq = -\frac{N}{R}\int_{\phi_i}^{\phi_f} d\phi$$

$$\Delta q = -2T\,\frac{N}{R}.A = \left(-\frac{100 \cdot 0{,}001\,m^2}{10\Omega} \cdot 2T\right)$$

$$\boxed{\Delta q = 0{,}02\ C}$$

$4\pi.10^{-7}$

PROBLEMA 5.9

$N = 100$; $R = 5\,\Omega$; $n = 200$ vtas/cm ; $3\,cm = D$

$1{,}5A \to i \to -1{,}5A$ en un $\Delta t = 0{,}05\,s$

$$B = \mu_0 . n . I = \mu_0 \frac{N}{\ell} . I$$

$$\phi = N B A$$

$$d\phi = N dB\, A$$

$$\frac{dB}{dt} = \mu_0\, n \cdot \frac{dI}{dt}$$

$$i(t) = \frac{e(t)}{R}$$

$$e(t) = -\frac{d\lambda}{dt} = -\frac{N\,d\phi}{dt} = -N A \int dB$$

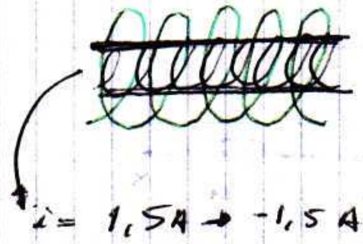
$$e(t) = -N.A.\int_{1{,}5A}^{1{,}5A} \mu_0 . n \; dI$$

NOTA

LENTINI PEDRO

5.9)

$N = 100$ $\qquad R = 5\,\Omega$



solenoide ideal infinito

$B = \mu_0 \cdot n \cdot i(t)$

En la bobina → $\lambda = N\, \vec{B}\, \vec{A}$ → sección del solenoide.

$\lambda = N \cdot B \cdot A$

$\lambda = 100 \cdot \underbrace{\mu_0 \cdot \frac{200}{cm}\, i(t)}_{B}\ \pi \cdot \frac{(0{,}03\,m)^2}{9}$ $\qquad (cm \to 10^{-2} m)$, $\quad 9 \cdot 10^{-4}\, m^2$

$e(t) = -\frac{d\lambda}{dt} = -450\, \mu_0 \cdot \pi\, \frac{d(i(t))}{dt}$

$i(t) = \frac{e(t)}{R} = -\frac{450 \mu_0 \pi}{5\,\Omega} \left(\frac{d\, i(t)}{dt}\right)$ → solenoide.

$i(t)$ bobina

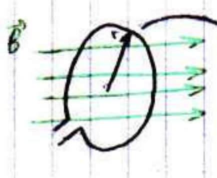
$i(t) = -450 \cdot \frac{4\pi \cdot 10^{-7} \cdot \pi}{5} \frac{\Delta i}{\Delta t} \frac{Wb}{A\, m\, \Omega}$

$i(t) = -450 \cdot 4\pi \cdot 10^{-7} \cdot \pi \cdot -\frac{3A}{0{,}05\,s}$

$\boxed{i(t) = 0{,}021\,A = 21\,mA}$

PROBLEMA 5.10

$\ell = 50\,cm \qquad d = 0{,}001016\ m$



$2\pi \cdot r = \ell \Rightarrow r = \frac{0{,}5\,m}{2\pi} \Rightarrow r = 0{,}08\,m$

$A = \pi \cdot r^2 = 0{,}0201\,m^2$

$e = \frac{d\lambda}{dt} = \frac{d\phi}{dt} = A \frac{dB}{dt}$

$e = 0{,}0201\,m^2 \cdot 100 \cdot 10^{-4}\, \frac{T}{s}$

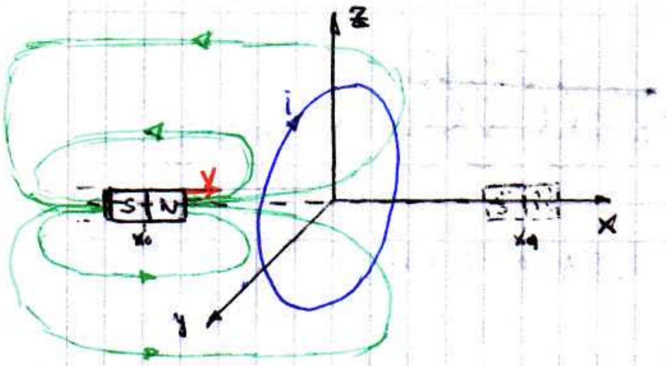
$e = 2{,}01 \cdot 10^{-4}\ V$

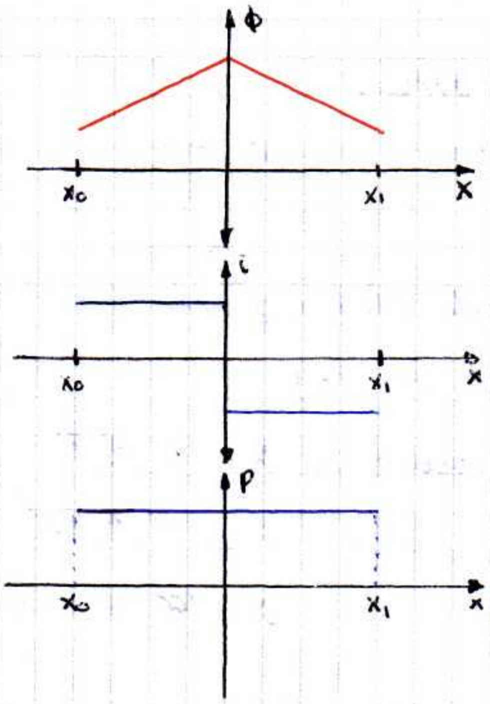
$R = \rho_{cobre} \frac{\ell}{A_{cable}} = 1{,}7 \cdot 10^{-8}\,\Omega \cdot m\, \frac{0{,}5\,m}{\pi (d/2)^2}$

$\boxed{R = 0{,}0105\ \Omega}$

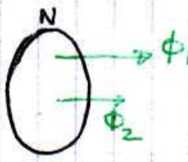
$P = V \cdot I = e\, \frac{e}{R} = \frac{e^2}{R} = \boxed{3{,}85\,\mu W}$

PROBLEMA 5.11





PROBLEMA 5.13



$$\frac{dQ}{dt} = \frac{e}{R}$$

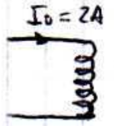
$$\frac{e}{R} = \frac{1}{R}\left(-\frac{d\lambda}{dt}\right)$$

$$\frac{dQ}{dt} = \frac{N}{R}\left(-\frac{d\phi}{dt}\right)$$

$$Q = -\frac{N}{R}\int_{\phi_2}^{\phi_1} d\phi$$

$$\boxed{Q = \frac{N}{R}\left(\phi_2 - \phi_1\right)}$$

PROBLEMA 5.14



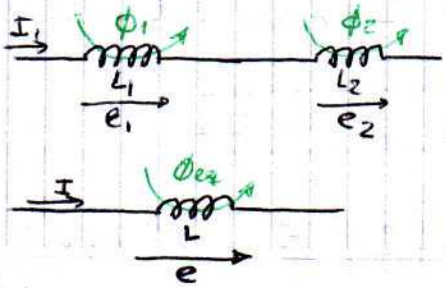
$L = 10H$ $\qquad I_F = 0\,A$

$$e = -\frac{d\lambda}{dt} = -L\frac{di}{dt} = -L\frac{\Delta i}{\Delta t} = -\frac{L(-2A)}{\Delta t} = 100V$$

$$\Delta t = \frac{L \cdot 2A}{100V} \Rightarrow \Delta t = \frac{10H \cdot 2A}{100V} \qquad \boxed{\Delta t = 0{,}2\,s}$$

PROBLEMA 5.15

L_1 y L_2 en serie y separados entre sí una gran distancia.



$$e_1 = -\frac{d\lambda_1}{dt} \qquad e_2 = -\frac{d\lambda_2}{dt} \qquad e = e_1 + e_2$$

$$I = I_1 = I_2$$

$$e = -\frac{d}{dt}\left(L_1 \cdot I_1 + \underset{0}{M} I_2\right) - \frac{d}{dt}\left(L_2 \cdot I_2 + \underset{0}{M} I_1\right)$$

$$d\lambda ext = B\,l\,dr$$

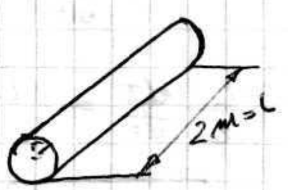
$$\lambda ext = \int_r^D \frac{\mu_0 . I\, l}{2\pi r}\, dr$$

$$\lambda ext = \frac{\mu_0 . I\, l}{2\pi} \ln\left(\frac{D}{r}\right)$$

$$\lambda total = 2\left(\lambda int + \lambda ext\right)$$

$$\lambda total = 2\left(\frac{\mu_0\, l\, I}{2\pi} \ln\left(\frac{D}{r}\right) + \frac{I\,\mu_0\,\mu_r}{4\pi}\right)$$

PROBLEMA 5.19



$r = 0{,}02\ m$

$d\ cable = 0{,}00254\ m$

$$N = \frac{L}{d\ cable} = \frac{2\ m}{0{,}00254\ m} \cong 787 \text{ vueltas}$$

$$B_{sol} = \frac{N}{L}\,\mu_0 . I$$

$$\phi = \frac{N}{L}\,\mu_0 . I . \pi r^2$$

$$\lambda = \frac{N^2}{L}\,\mu_0 . I\, \pi . r^2$$

$$L = \frac{\lambda}{I} = \frac{N^2}{L}\,\mu_0 . \pi . r^2 \Rightarrow \boxed{L = 489\,\mu H}$$

PROBLEMA 5.20

$$\phi = \frac{L . i}{N}$$

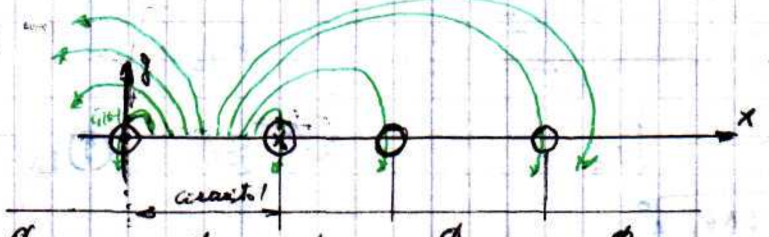
$$\phi = \frac{8\,mH . 5 . 10^{-3} A}{400}$$

$$\boxed{\phi = 0{,}1\ \mu Wb}$$

LENTINI PEDRO

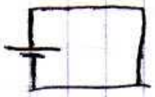
PROBLEMA 5.23

a)



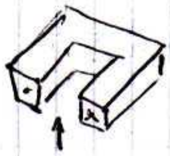
b) $e_2 = -\dfrac{d\lambda_{21}}{dt} = -N\dfrac{d\phi_{21}}{dt}$.

c) Para la polaridad de la espira la tengo que tomar como un generador.

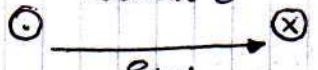


circuito ⊕ → ⊖

sentido del generador ⊖ → ⊕



Al aumentar $i(t)$, aumenta ϕ_2 y por la Ley de Lenz, la tensión inductiva debe generar una corriente que tienda a reducir el flujo concatenado.



d) $v_2 = M\dfrac{di}{dt}$

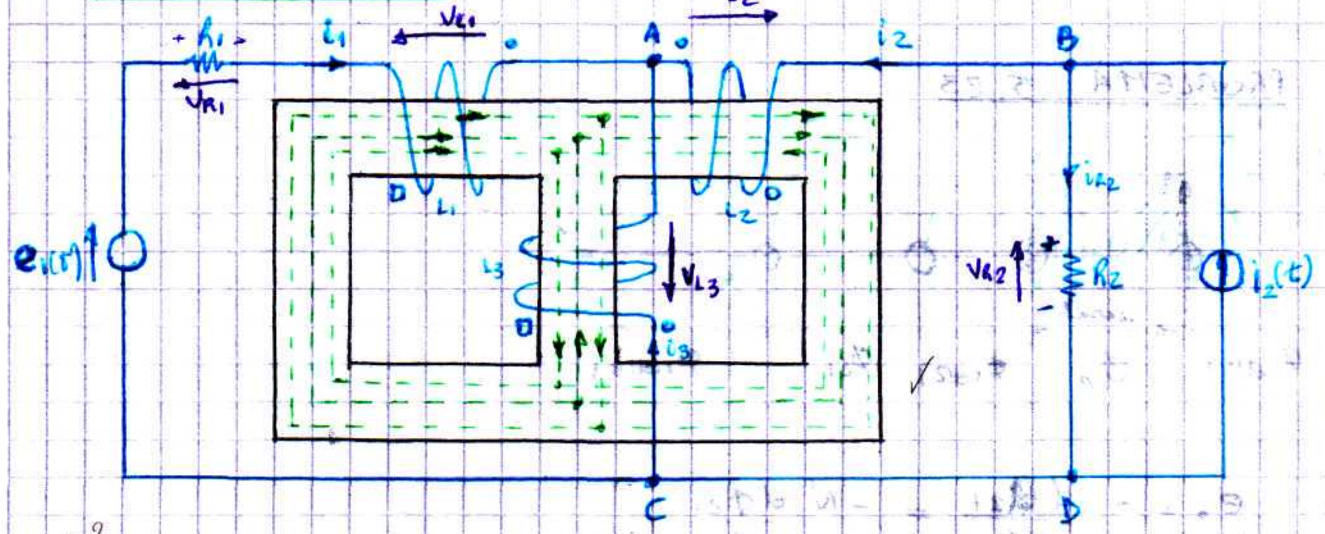
e) $i_2 \cdot L_2 = \phi_{2p} N_2 \qquad i_1 \cdot M = \phi_{21} N_2$

f) f1) $\lambda_2 = N_2\,\phi_{21} + N_2 \cdot \phi_{2p} = i_2 L_2 + i_1 M$

f2) $\lambda_{2p} = N_2\,\phi_{2p} = i_2 \cdot L_2$

f3) $\lambda_{21} = N_2\,\phi_{21} = M i_1$

PROBLEMA 5-24



d) Rama 1 $\quad V_A + V_{L1} + V_{R1} - e_1(t) = V_C$

$$V_A + \frac{d\lambda_{L1}}{dt} + R_1 \cdot i_1(t) - e_1(t) = V_C$$

Rama 2 $\quad V_A + V_{L3} = V_C$

$$V_A + \frac{d\lambda_{L3}}{dt} = V_C$$

Rama 3 $\quad V_A + V_{L2} - V_{R2} = V_C$

$$V_A + \frac{d\lambda_{L2}}{dt} - R_2\, i_{R2} = V_C$$

$$\lambda_{L1} = L_1 \cdot i_1 + M_{12} \cdot i_2 + M_{13} \cdot i_3$$

$$\lambda_{L2} = L_2 \cdot i_2 + M_{12} \cdot i_1 + M_{23} \cdot i_3$$

$$\lambda_{L3} = L_3 \cdot i_3 + M_{13} \cdot i_1 + M_{23} \cdot i_2$$

NOTA