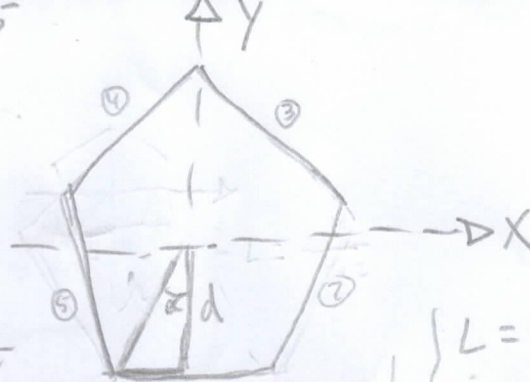


I)  $P = 400 \text{ mm}$   
 $\rho = 50 \text{ nC/m}$   
 $\epsilon = \epsilon_0$   
 $z = 30 \text{ mm}$



devido à simetria não  
 existe componente  
 quando  $z$  e a contribuição  
 dada por cada lado é igual

$$R = |\gamma_f - \gamma_i| = |(0, 0, z) - (x, d, 0)|$$

$$= \sqrt{x^2 + d^2 + z^2}$$

$$\vec{a}_r = \frac{\gamma_f - \gamma_i}{R} = \frac{(-x, d, z)}{\sqrt{x^2 + d^2 + z^2}}$$

$\vec{E}_T = 5 \vec{E}_{iz}$ , calculando  $\vec{E}_{iz}$

$$d\vec{E}_{iz} = \frac{\rho dx}{4\pi\epsilon_0 R^2} \cdot \frac{z}{R} \vec{u}_z = \vec{E}_{iz} = \frac{\rho dz}{4\pi\epsilon_0 R^3} \vec{u}_z = \frac{\rho z dz}{4\pi\epsilon_0 (x^2 + d^2 + z^2)^{3/2}} \vec{u}_z$$

$$\vec{E}_{iz} = \frac{\rho z}{4\pi\epsilon_0} \vec{u}_z \int_{-L}^L \frac{dx}{(x^2 + (d^2 + z^2))^{3/2}} =$$

$$= \frac{\rho z}{4\pi\epsilon_0} \vec{u}_z \left[ \frac{x}{(d^2 + z^2) \sqrt{x^2 + d^2 + z^2}} \right]_{-L}^L$$

$$= \frac{\rho z}{4\pi\epsilon_0} \frac{2L}{(d^2 + z^2) \sqrt{L^2 + d^2 + z^2}} \vec{u}_z$$

com  $\rho = 50 \times 10^{-9} \text{ C/m}$ ,  $L = 40 \times 10^{-3} \text{ m}$ ,  $d = 55 \times 10^{-3} \text{ m}$ ,  
 $z = 30 \times 10^{-3} \text{ m}$ ,  $\epsilon_0 = 8,854 \times 10^{-12} \text{ C}^2/\text{m}^2/\text{N}$  e  $\vec{E}_T = 5 \vec{E}_{iz}$

$$\vec{E}_T = \frac{5}{4\pi \times 8,854 \times 10^{-12}} \frac{50 \times 10^{-9} \times 30 \times 10^{-3} \times 2 \times 40 \times 10^{-3}}{[(55 \times 10^{-3})^2 + (30 \times 10^{-3})^2] \sqrt{(40 \times 10^{-3})^2 + (55 \times 10^{-3})^2 + (30 \times 10^{-3})^2}} \vec{u}_z$$

$$\vec{E}_T = \frac{600 \vec{u}_z}{111,26 \times 3,925 \times 10^{-3} \times 74,33 \times 10^{-3}} = 18,48 \text{ kV/m}$$

$$d\vec{E} = \frac{dq}{4\pi\epsilon R^2} \vec{a}_r$$

$$dq = \rho dl$$

$$L = \frac{P}{2 \times 5} ; \alpha = \frac{360}{2 \times 5} = 36$$

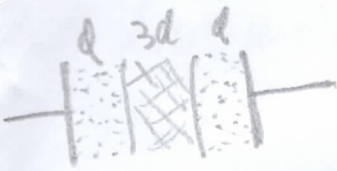
$$\tan \alpha = \frac{L}{d} \Rightarrow d = \frac{L}{\tan \alpha}$$

$$L = \frac{400 \times 10^{-3}}{10} = 40 \times 10^{-3} \text{ m}$$

$$d = \frac{40 \times 10^{-3}}{\tan(36)} = \frac{40 \times 10^{-3}}{0,727} = 55 \times 10^{-3} \text{ m}$$

$$\gamma_i = (x, d, 0)$$

$$\gamma_f = (0, 0, z)$$



$$\left\{ \begin{array}{l} \epsilon_r = 2\epsilon_{rc} \\ U = 2U_p + U_c \\ \phi_c = \phi_p \end{array} \right\} \left\{ \begin{array}{l} \frac{\epsilon_{rp}}{\epsilon_{rc}} = 2 \\ AD_c = AD_p \end{array} \right\} \left\{ \begin{array}{l} \epsilon_c E_c = \epsilon_p E_p \\ \epsilon_{rc} E_c = \epsilon_{rp} E_p \end{array} \right\}$$

$$\left\{ \begin{array}{l} U = 2U_p + U_c \\ E_c = 2E_p \end{array} \right\} \left\{ \begin{array}{l} \frac{U - U_c}{2} = U_p \\ E_c = 2 \frac{U_p}{d} \end{array} \right\} \left\{ \begin{array}{l} E_c = 2 \frac{U - U_c}{2d} \\ E_c = \frac{U}{d} - \frac{U_c}{d} \end{array} \right\}$$

$$E_c = \frac{U}{d} - 3 \frac{U_c}{3d} \Rightarrow E_c = \frac{U}{d} - 3E_c \Rightarrow E_c = \frac{U}{4d} //$$

IV

$$A = 5 \text{ cm}^2$$

$$n = 100 \text{ sp.}$$

$$I_1 = 100 \text{ mA} \Rightarrow B_1 = 250 \text{ mT}$$

$$I_2 = 200 \text{ mA} \Rightarrow B_2 = 500 \text{ mT}$$

$$\frac{B_1}{I_1} = \frac{250}{100} = 2,5$$

$$\frac{B_2}{I_2} = \frac{500}{200} = 2,5$$

$$\frac{B_1}{I_1} = \frac{B_2}{I_2}$$

zona linear

$$L = \frac{N^2}{R} \text{ e } L = \frac{N \Phi}{I}$$

$$\frac{N \Phi}{R} = \frac{N B A}{I} \Rightarrow R = \frac{N I}{B A}$$

$$R = \frac{100}{5 \times 10^{-4}} \times \frac{1}{2,5} = 80000 \text{ H}^{-1}$$

$$R = \frac{100 \times 10^{-3} \times 10^{-3}}{5 \times 10^{-4} \times 2,5} = 80000 \text{ H}^{-1}$$

IV

$$A = 5 \text{ cm}^2$$

$$n = 250 \text{ sp.}$$

$$I = 15 \text{ A}$$

$$PF \left\{ \begin{array}{l} B = 1,15 \text{ T} \\ H = 4800 \text{ A/m} \end{array} \right.$$

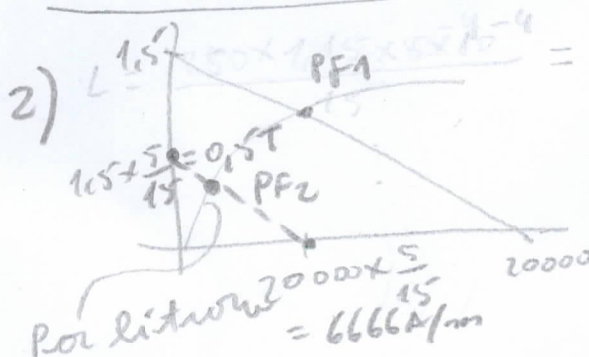
$$H = 4800 \text{ A/m}$$

$$PF_2 \left\{ \begin{array}{l} B = 0,45 \text{ T} \\ H = \dots \text{ A/m} \end{array} \right.$$

$$L = \frac{N \Phi}{I} = \frac{250 \times 0,45 \times 5 \times 10^{-4}}{15}$$

$$L = 11,25 \text{ mH} //$$

$$1) L = \frac{N \Phi}{I} = \frac{250 \times 1,15 \times 5 \times 10^{-4}}{15} = 9,58 \text{ mH} //$$



$$NI = R \Phi$$

$$NI = (R_l + R_g) BA$$

$$NI = \left( \frac{l_l}{\mu_l A} + \frac{l_g}{\mu_0 A} \right) BA$$

$$NI = l_l \mu_l + \frac{l_g}{\mu_0} B$$

$$\text{são omhos} \left\{ \begin{array}{l} B = 0 \Rightarrow H_{l0} = \frac{NI}{l_l} \\ H_g = 0 \Rightarrow B_0 = \frac{NI \mu_0}{l_g} \end{array} \right.$$



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3/3

II)

$$-1,75 \frac{-5-8}{33-23} = 1,625V$$

$$N=500$$

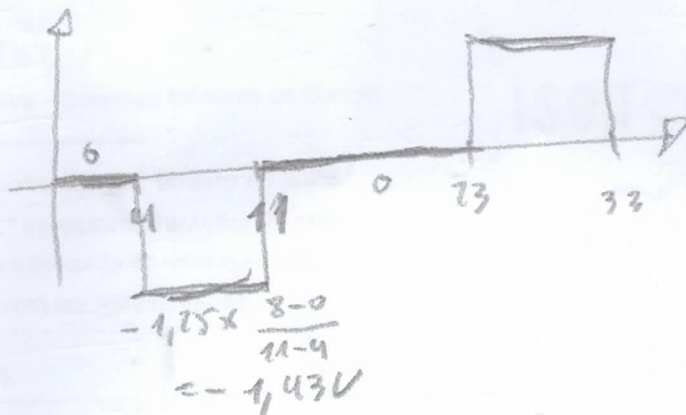
$$S=25 \text{ cm}^2$$

$$U = -N \frac{d\Phi}{dt}$$

$$U = -NA \frac{dB}{dt}$$

$$U = -500 \times 25 \times 10^{-4} \times \frac{dB}{dt}$$

$$U = 1,25 \times \frac{dB}{dt}$$



$$U_{RMS}^2 = \frac{1}{33 \times 10^{-3} - 0} \left( \int_0^{4 \times 10^{-3}} 0^2 dt + \int_{4 \times 10^{-3}}^{11 \times 10^{-3}} (-1,43)^2 dt + \int_{11 \times 10^{-3}}^{23 \times 10^{-3}} 0^2 dt + \int_{23 \times 10^{-3}}^{33 \times 10^{-3}} 1,625^2 dt \right)$$

$$U_{RMS}^2 = \frac{1}{33 \times 10^{-3}} \left( 0 + 1,43^2 (11-4) \times 10^{-3} + 0 + 1,625^2 (33-23) \times 10^{-3} \right)$$

$$U_{RMS} = \sqrt{1,234} = 1,11V //$$