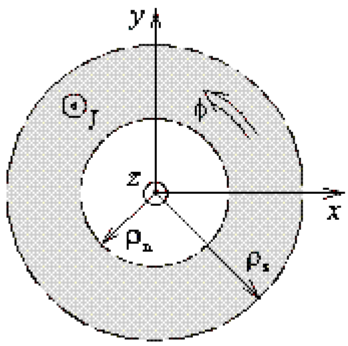
Cevasti vodnik z notranjim polmerom ρ_{n} in zunanjim ρ_{z} vodi tok I z enakomerno gostoto po prerezu. Določite izraz za količino magnetnega pretoka na enoto dolžine v cevi (med polmeroma ρ_{n} in ρ_{z})!



Rešitev:

$$\oint_{\mathcal{L}} \vec{B}\cdot \mathrm{d}\vec{l} = \mu_0 \int_{\mathcal{A}} \vec{J}\cdot \mathrm{d}\vec{a}$$

$$\vec{B} = \vec{e}_{\varphi} B_{\varphi}(\rho)$$

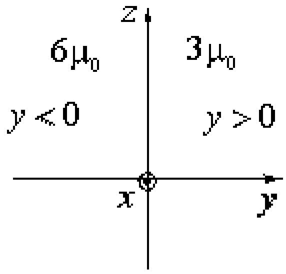
$\rho_{\mathrm{n}} \le \rho \le \rho_{\mathrm{z}}$:

$$2\pi\rho B_{\varphi}(\rho) = \mu_0 \frac{I}{\pi\left(\rho_{\mathrm{z}}^2 - \rho_{\mathrm{n}}^2\right)}\pi\left(\rho^2 - \rho_{\mathrm{n}}^2\right)$$

$$B_{\varphi}(\rho) = \frac{\mu_0 I}{2\pi\left(\rho_{\mathrm{z}}^2 - \rho_{\mathrm{n}}^2\right)}\left(\rho - \frac{\rho_{\mathrm{n}}^2}{\rho}\right)$$

$$\phi' = \frac{\mathrm{d}\phi}{\mathrm{d}l} = \int_{\rho_{\mathrm{n}}}^{\rho_{\mathrm{z}}} B_{\varphi}(\rho)\,\mathrm{d}\rho = \frac{\mu_0 I}{2\pi\left(\rho_{\mathrm{z}}^2 - \rho_{\mathrm{n}}^2\right)}\left(\frac{\rho_{\mathrm{z}}^2 - \rho_{\mathrm{n}}^2}{2} - \rho_{\mathrm{n}}^2 \ln\frac{\rho_{\mathrm{z}}}{\rho_{\mathrm{n}}}\right) = \frac{\mu_0 I}{2\pi}\left(\frac{1}{2} - \frac{\rho_{\mathrm{n}}^2}{\rho_{\mathrm{z}}^2 - \rho_{\mathrm{n}}^2}\ln\frac{\rho_{\mathrm{z}}}{\rho_{\mathrm{n}}}\right)$$

Ravnina $y = 0$ je meja dveh linearnih feromagnetikov. V območju $y < 0$ je vektor jakosti magnetnega polja $\vec{H} = (50, 100, 50)$ A/m. Določite vektor gostote magnetnega polja $\vec{B}$ v območju $y > 0$, če je meja $y = 0$ brez tokovne obloge!



Rešitev:

$\vec{n} \cdot \left(\vec{B}(T_+) - \vec{B}(T_-)\right) = 0 \Rightarrow B_y(y > 0) = B_y(y < 0)$

$\vec{n} \times \left(\vec{H}(T_+) - \vec{H}(T_-)\right) = \vec{K}(T)$, $\vec{K} = \vec{0} \Rightarrow H_x(y > 0) = H_x(y < 0)$, $H_z(y > 0) = H_z(y < 0)$

$\vec{B} = \mu \vec{H}$

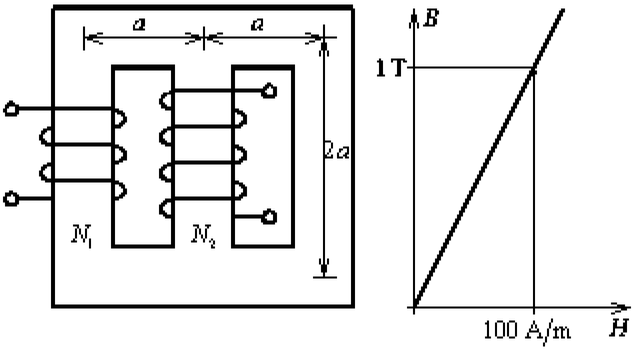
$B_y(y > 0) = 6\mu_0 H_y(y < 0)$

$B_x(y > 0) = 3\mu_0 H_x(y < 0)$

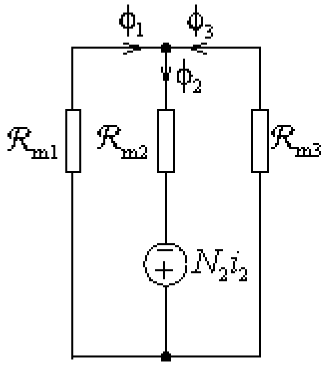
$B_z(y > 0) = 3\mu_0 H_z(y < 0)$

$\vec{B}(y > 0) \cong (60, 240, 60)\pi \cdot 10^{-6}$ T

Dano je magnetno jedro z dano linearno magnetilno krivuljo, $N_1 = 200$ ovojev, $N_2 = 400$ ovojev, $a = 10\,\text{cm}$ in presek jedra $A = 10\,\text{cm}^2$. Izračunajte medsebojno induktivnost navitij L_{12}!



Rešitev:



$$L_{12} = \frac{\psi_1^{(2)}}{i_2}, \; \psi_1^{(2)} = N_1 \phi_1^{(2)}$$

$$\mathcal{R}_{m1} = \mathcal{R}_{m3} = \frac{1}{\mu}\frac{4a}{A}, \; \mathcal{R}_{m2} = \frac{1}{\mu}\frac{2a}{A}$$

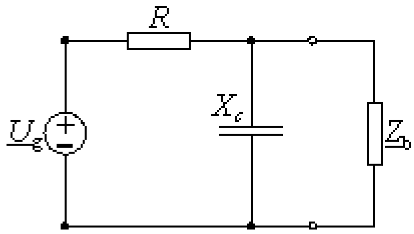
$$\mu = \frac{1\,\text{T}}{100\,\text{A/m}} = 0.01\,\frac{\text{Vs}}{\text{Am}}$$

$$\mathcal{R}_{m1} = \mathcal{R}_{m3} \Rightarrow \phi_1^{(2)} = \frac{1}{2}\phi_2^{(2)}$$

$$\phi_2^{(2)} = \frac{N_2 i_2}{\mathcal{R}_{m2} + \frac{\mathcal{R}_{m1}\mathcal{R}_{m3}}{\mathcal{R}_{m1} + \mathcal{R}_{m3}}} = \frac{N_2 i_2}{\mathcal{R}_{m2} + \frac{1}{2}\mathcal{R}_{m1}} = \frac{N_2 i_2 \mu A}{4a}$$

$$\phi_1^{(2)} = \frac{N_2 i_2 \mu A}{8a}, \; L_{12} = \frac{N_1 N_2 i_2 \mu A}{i_2 8a} = \frac{N_1 N_2 \mu A}{8a} = 1\,\text{H}$$

Pri kateri impedanci $\underline{Z}_b$ bo delovna moč na bremenu največja in kolikšna je ta moč? Upornost upora je $R = 1\,\Omega$, reaktanca kondenzatorja je $X_C = 2\,\Omega$, kompleksor maksimalne vrednosti napetosti vira je $\underline{U}_g = 4$ V.



Rešitev:

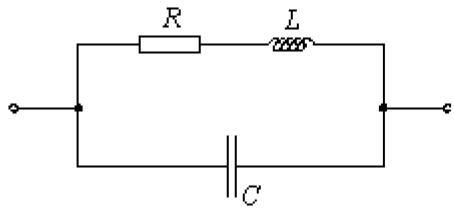
$$\underline{Z}_T = R \| (-jX_C) = \frac{-jX_C R}{R - jX_C} = \frac{-2j}{1-2j}\,\Omega$$

$$\underline{U}_T = \underline{U}_g \frac{1}{R - jX_C}(-jX_C) = \frac{-8j}{1-2j}\,\text{V} \;,\; U_T = \frac{8}{\sqrt{5}}\,\text{V}$$

$$\underline{Z}_b = \underline{Z}_T^* = \frac{2j}{1+2j}\,\Omega = \frac{2j(1-2j)}{1+4}\,\Omega = \frac{4+2j}{5}\,\Omega = (0.8 + 0.4j)\,\Omega$$

$$P_{b\,\text{max.}} = \frac{U_T^2}{8R_T} = \frac{64/5}{8 \cdot 0.8}\frac{\text{V}^2}{\Omega} = 2\text{ W}$$

Določite izraz za resonančno frekvenco danega vezja!



Rešitev:

$$\underline{Y} = \mathrm{j}\omega C + \frac{1}{R + \mathrm{j}\omega L} = \frac{R}{R^2 + (\omega L)^2} + \mathrm{j}\left(\omega C - \frac{\omega L}{R^2 + (\omega L)^2}\right)$$

$$\mathrm{Im}\left[\underline{Y}\right] = 0 \Rightarrow R^2 + (\omega_0 L)^2 = \frac{L}{C}$$

$$\omega_0 L = \sqrt{\frac{L}{C} - R^2}$$

$$\omega_0 = \sqrt{\frac{1}{LC} - \left(\frac{R}{L}\right)^2}$$