Izračunajte magnetno napetost $\Theta = \int\limits_{A}^{B} \vec{H} \cdot \mathrm{d}\vec{l}$ vzdolž krivulje $\mathscr{L}$ med točko A in točko B v okolici treh vodnikov po sliki ($i = 50$ A, $a = 0.2$ m)!

Rešitev:

$$\Theta_{AB} = \int\limits_{A}^{B} \vec{H} \cdot \mathrm{d}\vec{l} = \sum_{k} \frac{i_k}{2\pi} \cdot \varphi_k$$

$$\Theta_{AB} = \frac{2i}{2\pi} \cdot \frac{\pi}{2} - \frac{3i}{2\pi} \cdot \frac{\pi}{4} - \frac{2i}{2\pi} \cdot \mathrm{arctg} \frac{2a}{a}$$

$$\Theta_{AB} = -0.23i = -11.4 \mathrm{A}$$
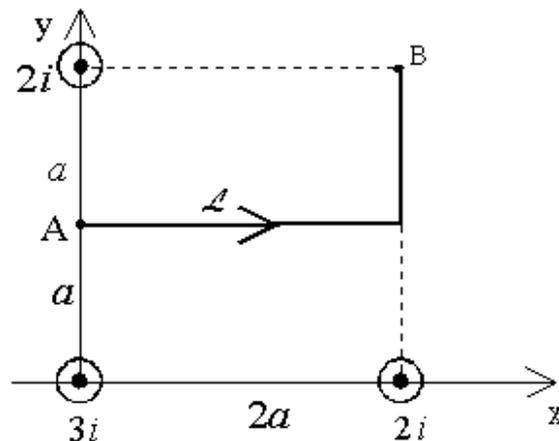
Po dvovodu omrežne napetosti 230 V/50 Hz teče tok efektivne vrednosti 25 A. Kolikšna efektivna napetost se inducira v vzporednem telefonskem vodu v dolžini 100 m po sliki ($a = 0.4$ m, $b = 0.2$ m, $c = 0.2$ m)?

telefonski vod

Rešitev:

$$U_i = -\frac{\mathrm{d}\Phi}{\mathrm{d}t} = -M\frac{\mathrm{d}i}{\mathrm{d}t}$$

$$\Phi = \mu_0 \frac{i}{2\pi} l \cdot \left(-\ln\frac{\sqrt{a^2 + (b+c)^2}}{\sqrt{a^2 + b^2}} + \ln\frac{b+c}{b} \right) = M \cdot i$$

$$M = 4\pi 10^{-7} \cdot \frac{100}{2\pi} \ln\frac{0.4\sqrt{0.4^2 + 0.2^2}}{0.2\sqrt{0.4^2 + 0.4^2}} = 9.16\,\mu\mathrm{H}$$

$$i = 25\sqrt{2}\cos 314t$$

$$\frac{\mathrm{d}i}{\mathrm{d}t} = -25\sqrt{2} \cdot 314\sin 314t$$

$$U = \omega IM = 314 \cdot 25 \cdot 9.16 \cdot 10^{-6} = 71.9\,\mathrm{mV}$$
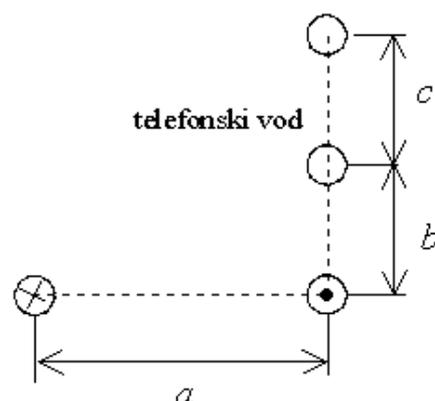
Ravnina $x = 0$ je meja dveh linearnih magnetnih snovi. V prostoru $x < 0$ je $\mu = 100\,\mu_0$ in vektor gostote magnetnega pretoka $\vec{B} = \vec{e}_x\,5 + \vec{e}_y\,2 + \vec{e}_z\,3\,\mathrm{mT}$. V prostoru $x > 0$ je $\mu = 20\,\mu_0$. Na meji ni tokovne obloge. Kolikšen je vektor $\vec{B}$ v prostoru $x > 0$?

Rešitev:

$B_{1n} = B_{2n}\,,\ B_n = B_x$

$H_{1t} = H_{2t}\,,\quad B_{2t} = \dfrac{\mu_2}{\mu_1}\,B_{1t}\,,\quad B_{2y} = \dfrac{20\mu_0}{100\mu_0}\cdot 2 = 0.4\ \mathrm{mT},\quad B_{2z} = \dfrac{20\mu_0}{100\mu_0}\cdot 3 = 0.6\,\mathrm{mT}$

$\vec{B}_{(x>0)} = \vec{e}_x\,5 + \vec{e}_y\,0.4 + \vec{e}_z\,0.6\,\mathrm{mT}$

Kolikšna je impedanca $\underline{Z}$ med sponkama a in b $(k = 0.5)$?

Rešitev:

$$X_M = k\sqrt{X_{L1} \cdot X_{L2}} = 0.5\sqrt{10 \cdot 40} = 10\,\Omega$$

$$\underline{U} = \underline{I}_1\left(10 + j10\right) + \underline{I}_1 \cdot j10$$

$$0 = \underline{I}_1\, j10 + \underline{I}_2\, j40 \rightarrow \underline{I}_2 = -\frac{\underline{I}_1}{4}$$

$$\underline{Z} = \frac{\underline{U}}{\underline{I}_1} = 10 + j7.5\,\Omega$$
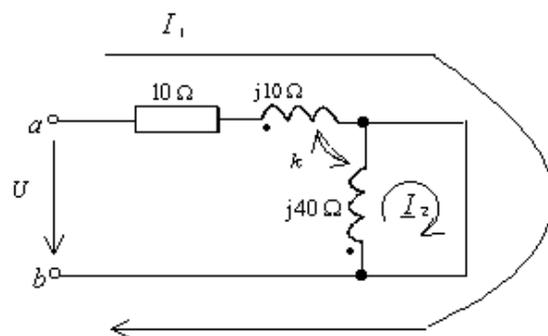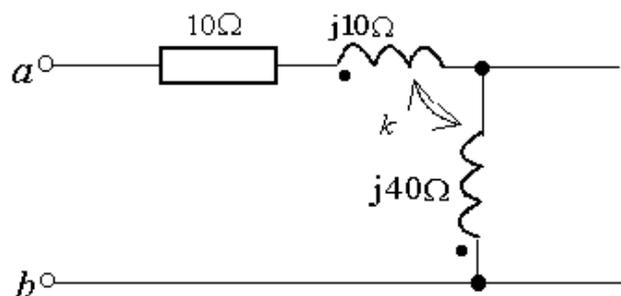
Trifazno breme je priključeno na simetrično trifazno omrežje 3x400/230 V s pozitivnim faznim zaporedjem napetosti. Kolikšna je delovna moč, ki se troši na bremenu?

Rešitev:

$$P = U_A'^2 / R_A$$

$$\underline{U}_A' = \underline{U}_A - \underline{U}_0 \,, \quad \underline{U}_0 = \underline{I}_0 \cdot \underline{Z}_0$$

$$\underline{I}_0 = \frac{\underline{U}_A}{\underline{Z}_A} + \frac{\underline{U}_b}{\underline{Z}_b} + \frac{\underline{U}_c}{\underline{Z}_c} = 2.3 + j2.3 \ A$$

$$\underline{Z}_0 = \frac{1}{1/\underline{Z}_A + 1/\underline{Z}_B + 1/\underline{Z}_c} = 20 + j40$$

$$\underline{U}_0 = -46 + j138 \, V$$

$$\underline{U}_A = 276 - j138 \, V$$

$$P = 952.2 \ W$$