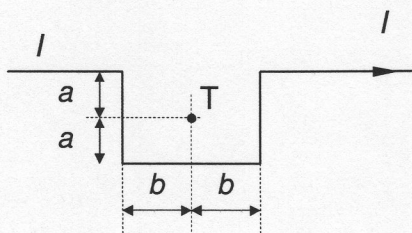
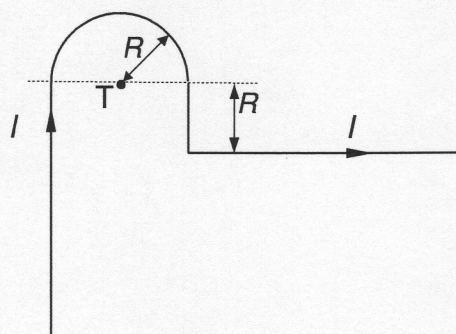


6. domača naloga iz Osnov elektrotehnike 1 (VS)

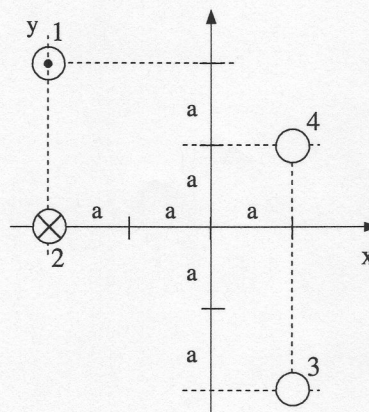
1. Izračunajte magnetno poljsko jakost H , ki jo v točki T povzroča tok $I = 12 \cdot \pi$ A, ki teče po lomljenem vodniku, kot je prikazano na sliki ($a = 3$ cm, $b = 4$ cm). Konca vodnikov gresta proti neskončno.



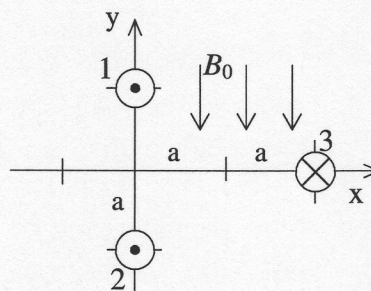
2. Izračunajte magnetno poljsko jakost H , ki jo v točki T povzroča tok $I = 10 \cdot \pi$ A, ki teče po lomljenem vodniku in delu krožne zanke (1/2 kroga), kot je prikazano na sliki ($R = 5$ cm). Konca vodnikov gresta proti neskončno. Točka je v središču krožne zanke.



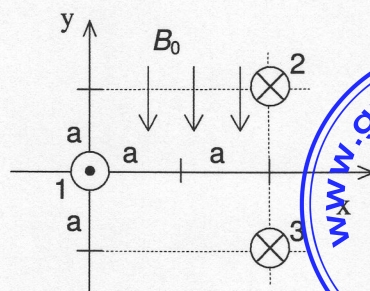
3. Določite magnetni pretok, ki ga tok po vodnikih 1 in 2 (na sliki) povzroča skozi zanko, ki jo tvorita vodnika 3 in 4 (na razdalji 100m, $a = 30$ cm, $I = 20$ A).



4. Izračunajte silo na vodnik 3, ki se nahaja v homogenem magnetnem polju $B_0 = 20 \cdot 10^{-6}$ T, in v polju vzporedno ležečih vodnikov 1 in 2 kot kaže slika ($I_1 = I_2 = 50$ A, $I_3 = 10$ A in $a = 20$ cm).



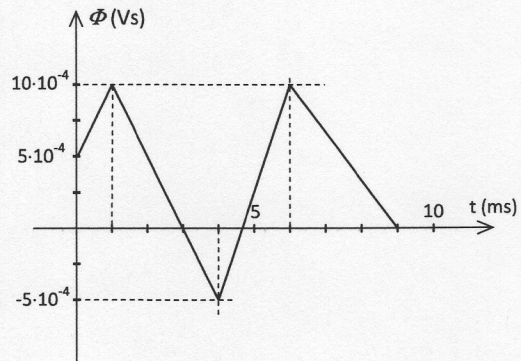
5. Izračunajte kako veliko bi moralo biti homogeno magnetno polje B_0 , da bi bila vsota sil na vodnik 1 enaka 0. Vodnik je v polju vzporedno ležečih vodnikov 2 in 3 kot kaže slika ($I_1 = 10$ A, $I_2 = I_3 = 25$ A in $a = 50$ cm).



$$\mu_0 = 4 \cdot \pi \cdot 10^{-7} \text{ Vs/Am}$$



6. Izračunajte in narišite potek inducirane napetosti v tuljavi z $N = 200$ ovoji, če se skozi njo spreminja magnetni pretok ϕ tako kot je prikazano na sliki.



Rešitve:

$$1. \vec{H} = +\vec{1}_z \ 300 \text{ A/m}$$

$$(-20 + 90 + 160 + 90 - 20) \text{ A/m}$$

$$2. \vec{H} = -\vec{1}_z \ 227,8 \text{ A/m}$$

$$(-50 - 157,1 - 35,35 + 14,64) \text{ A/m}$$

$$\Phi_{12,34} = 1,31 \cdot 10^{-4} \text{ Vs}$$

$$3. \Phi_{1,34} = 1,83 \cdot 10^{-4} \text{ Vs}$$

$$\Phi_{2,34} = 0,52 \cdot 10^{-4} \text{ Vs}$$

$$4. \vec{F}_3 = 2 \cdot 10^{-4} \vec{1}_x \text{ N}$$

$$5. B_0 = 8 \cdot 10^{-6} \text{ T}$$

$$6. U_{i1} = -100 \text{ V}$$

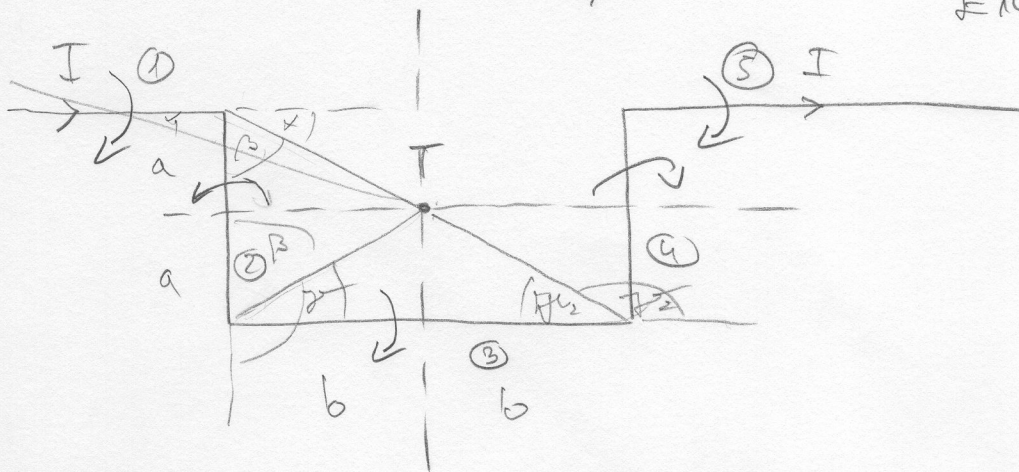
$$U_{i2} = +100 \text{ V}$$

$$U_{i3} = -150 \text{ V}$$

$$U_{i4} = 66,7 \text{ V}$$

$$\mu_0 = 4 \cdot \pi \cdot 10^{-7} \text{ Vs/Am}$$





$$I = 12\pi \text{ A}$$

$$a = 3 \text{ cm}$$

$$b = 4 \text{ cm}$$

$$\sqrt{a^2 + b^2} = 0,05$$

$$H_1 = \frac{3 \cdot 12\pi \cdot 10^2}{4\pi \cdot 3 \cdot 10^{-2}} \left(1 - \frac{b}{\sqrt{a^2 + b^2}} \right) = 300 \cdot \left(1 - \frac{4 \cdot 10^{-2}}{\sqrt{9 \cdot 10^{-4} + 16 \cdot 10^{-4}}} \right) = 20 \frac{\text{A}}{\text{m}} = H_5$$

$$H_2 = \frac{12\pi \cdot 3 \cdot 10^2}{4\pi \cdot 4 \cdot 10^{-2}} \left(\frac{a}{\sqrt{a^2 + b^2}} + \frac{a}{\sqrt{a^2 + b^2}} \right) = 90 \frac{\text{A}}{\text{m}} = H_4$$

$$H_3 = \frac{12\pi \cdot 3 \cdot 10^2}{4\pi \cdot 3 \cdot 10^{-2}} \left(\frac{2b}{\sqrt{a^2 + b^2}} \right) = 160 \frac{\text{A}}{\text{m}}$$

$$H_T = (-20 - 20 + 90 + 90 + 160) = 300 \frac{\text{A}}{\text{m}}$$

$$\vec{H} = \vec{H} \cdot 300 \frac{\text{A}}{\text{m}}$$

DN 6 / 2,

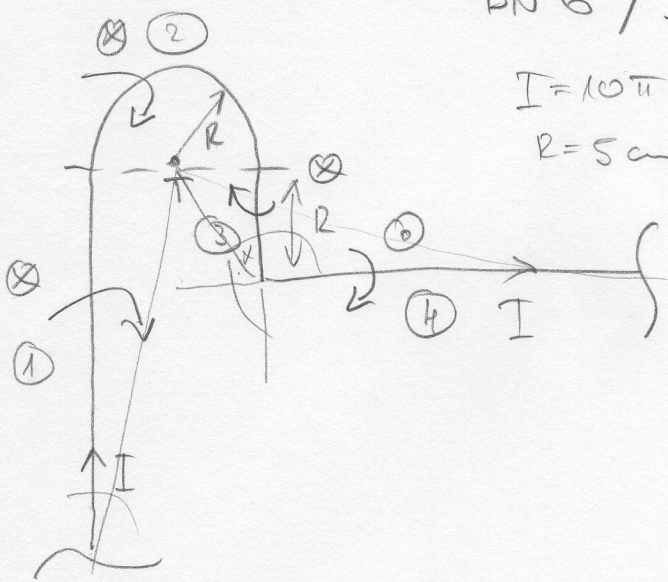
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$$I = 10\pi \text{ A}$$

$$R = 5 \text{ cm}$$

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$$H_1 = \frac{10\pi \cdot 10^2}{4\pi \cdot 5 \cdot 10^{-2}} (1 - 0) = \frac{1000}{20} = 50 \frac{\text{A}}{\text{m}} \otimes$$

$$H_2 = \frac{10\pi}{4\pi \cdot 5 \cdot 10^{-2}} = 157,0796 \frac{\text{A}}{\text{m}} \otimes$$

$$H_3 = \frac{10\pi}{4\pi \cdot 5 \cdot 10^{-2}} \left(0 + \frac{R}{\sqrt{R^2 + R^2}} \right) = 35,355 \frac{\text{A}}{\text{m}} \otimes$$

$$H_4 = \frac{10\pi}{4\pi \cdot 5 \cdot 10^{-2}} \left(\frac{R}{\sqrt{R^2 + R^2}} + 1 \right) = 14,644 \frac{\text{A}}{\text{m}} \odot$$

$$\vec{H} = -\vec{1}_z (-H_1 - H_2 \quad H_3 + H_4) = \vec{1}_z 227,79 \frac{\text{A}}{\text{m}}$$

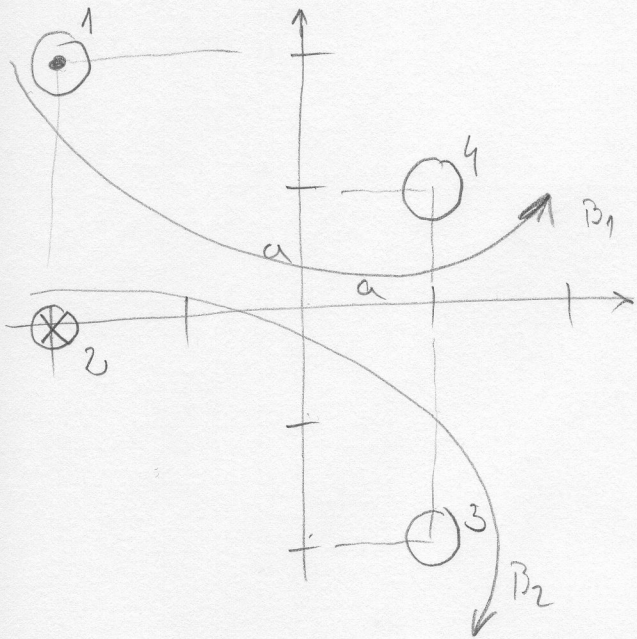


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$$\Phi_{1,34} = \frac{\mu_0 I \cdot l}{2\pi} \ln \frac{5}{3,16} = 18,35 \cdot 10^{-5} \text{ V/m}$$

$$\Phi_{2,34} = \frac{\mu_0 I l}{2\pi} \ln \frac{3,16}{5,16} = -5,325 \cdot 10^{-5} \text{ V/m}$$

$$l = 100 \text{ m}$$

$$a = 30 \text{ cm} = 0,3 \text{ m}$$

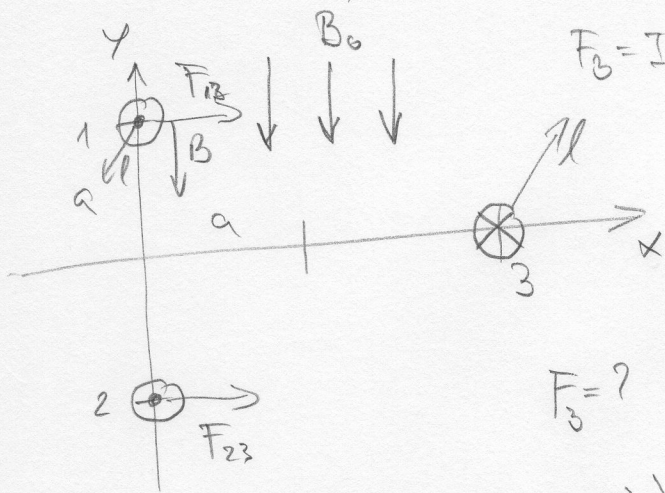
$$I = 20 \text{ A}$$

$$\Phi_{12,34} = \Phi_{1,34} + \Phi_{2,34} = 23,68 \cdot 10^{-5} \text{ V/m}$$



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$$F_3 = I (\vec{l}_3 \times \vec{B}_0) = -I_2 \times (-\vec{l}_y) = -\vec{l}_x$$

$$I_1 = I_2 = 50 \text{ A}$$

$$I_3 = 10 \text{ A}$$

$$a = 20 \text{ cm} = 0.2 \text{ m}$$

$$B_0 = 20 \cdot 10^{-6} \text{ T}$$

xyzyz

$$F_3 = ?$$

$$\vec{F}_{13} = I_1 (\vec{l}_1 \times \vec{B}_1) \Rightarrow \vec{l}_2 \times (-\vec{l}_y) \Rightarrow \vec{l}_x$$

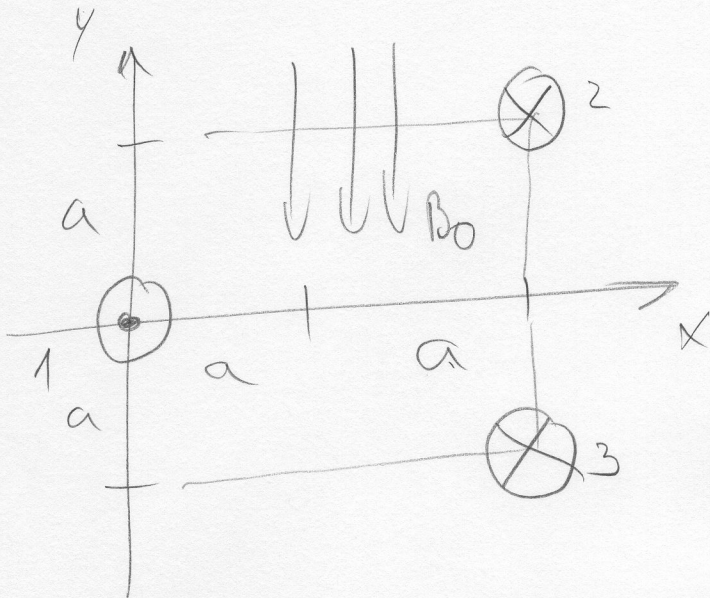
$$F_{13} = \frac{I_1 I_3 \mu_0}{2\pi r_{13}} \vec{l}_{13} = \frac{500 \cdot \mu_0}{2\pi \cdot 0.2 \sqrt{5}} \left(\vec{l}_x \frac{2}{\sqrt{5}} - \vec{l}_y \frac{1}{\sqrt{5}} \right) = \vec{l}_x 2 \cdot 10^{-4} - 1 \cdot 10^{-4} \vec{l}_y$$

$$F_{23} = \frac{I_2 I_3 \mu_0}{2\pi r_{23}} \vec{l}_{23} = \frac{500 \mu_0}{2\pi \cdot 0.2 \sqrt{5}} \left(\vec{l}_x \frac{2}{\sqrt{5}} + \vec{l}_y \frac{1}{\sqrt{5}} \right) = \left(\vec{l}_x 2 \cdot 10^{-4} + 1 \cdot 10^{-4} \vec{l}_y \right)$$

$$F_0 = I_3 B_0 = 10 \cdot 20 \cdot 10^{-6} \cdot (\vec{l}_x) = 2 \cdot 10^{-4} \vec{l}_x$$

$$F_3 = F_{13} + F_{23} + F_0 = \underline{\underline{\vec{l}_x 2 \cdot 10^{-4} \text{ N}}}$$





$$I_1 = 10 \text{ A}$$

$$I_2 = I_3 = 25 \text{ A}$$

$$a = 50 \text{ cm} = 0,5 \text{ m}$$

$$B_0 = ? \Rightarrow F_1 = 0$$

$$F_{21} = \frac{I_2 I_1 \mu_0 l}{2\pi r_{12}} \vec{r}_{12} = \frac{250 \mu_0}{2\pi \cdot 0,5 \sqrt{5}} \left(-\vec{r}_x \frac{2}{\sqrt{5}} - \vec{r}_y \frac{1}{\sqrt{5}} \right) = -\vec{r}_x 4 \cdot 10^{-5} \vec{r}_y 2 \cdot 10^{-5} \text{ N}$$

$$F_{31} \quad \vec{r}_x 4 \cdot 10^{-5} + \vec{r}_y 2 \cdot 10^{-5} \text{ N}$$

$$F_0 = I_1 \cdot B_0 \quad B_0 = \frac{-\vec{r}_x 8 \cdot 10^{-5}}{-\vec{r}_x 10} \quad \underline{\underline{8 \cdot 10^{-6} \vec{r}_x \text{ T}}}$$

$$F_0 = F_{21} + F_{31}$$

$$F_0 = (\vec{I} \times \vec{B}) \cdot l \Rightarrow \vec{r}_2 \times (\vec{r}_y) = \vec{r}_x$$

$$U_i = -N \frac{\Delta \Phi}{\Delta t}$$

$$U_{11} = 200 \frac{5 \cdot 10^{-4}}{1 \cdot 10^{-3}} = -100 \text{ V}$$

$$U_{21} = -200 \cdot \frac{-15 \cdot 10^{-4}}{3 \cdot 10^{-3}} = 100 \text{ V}$$

$$U_{31} = 200 \frac{15 \cdot 10^{-4}}{2 \cdot 10^{-3}} = -150 \text{ V}$$

$$U_{41} = -200 \cdot \frac{-10 \cdot 10^{-4}}{3 \cdot 10^{-3}} = 66,67 \text{ V}$$

