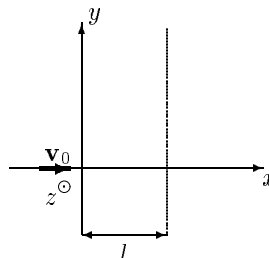


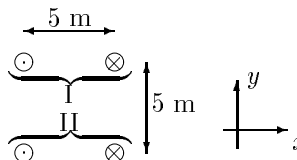
1. kolokvij OE II

14.04.1999

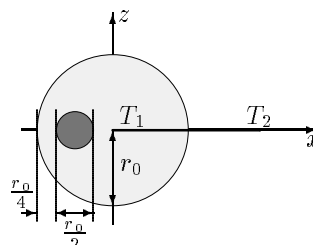
1. Elektrine $Q = 1.6 \cdot 10^{-18}$ As z maso $m = 2 \cdot 10^{-20}$ kg vpihujemo v prostor $x > 0$ v koordinatnem izhodišču s hitrostjo $\mathbf{v}_0 = 1_x 4$ m/s. Določite razdaljo med pikama na $l = 20$ cm oddaljenem zaslonu, če v prvem primeru vklopimo le $\mathbf{E} = 1_y 5$ V/m, v drugem pa samo $\mathbf{B} = 1_z 0.25$ T.



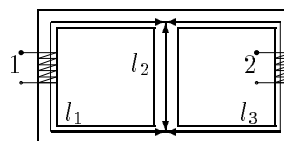
2. Dvodova s tokoma $I_1 = I_2 = 100$ A potekata vzporedno, kot kaže slika. Določite silo na enoto dolžine na enega od vodnikov!



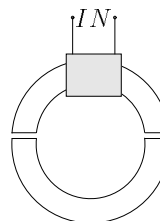
3. Določite magnetni pretok ϕ skozi del ravnine $z = 0$ dolžine $l_y = 1$ km, ki ga v prerezu omejujeta točki $T_1(0, y, 0)$ in $T_2(2r_0, y, 0)$! Ploskovna gostota toka v votlem vodniku $r_0 = 4$ cm je $J = 10$ A/m².



4. Določite lastno induktivnost navitja 1 z $N_1 = 100$ ovoji, če je jedro iz feromagnetnega materiala z magnetno permeabilnostjo $\mu \approx \frac{1}{800}$ Vs/Am. Srednje dolžine so $l_1 = l_3 = 3 \cdot l_2 = 12$ cm, ploščina prereza pa $A = 10$ cm².



5. Kolikšna je sila med deloma jedra $\mu = 1200\mu_0$ na sliki, če je $IN = 1000$ Aov? Toroid je v prerezu kvadrat s stranico $h = 2$ cm in notranjim polmerom $r_1 = 9$ cm. Magnetno upornost rež zanemarite.



Na izdelek napišite ime, priimek in vpisno številko.

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

Rešitve nalog

za 1. kolokvij OE II 14.04.1999

1. $E \neq 0$: $a_y = \frac{QE}{m} = 400 \text{ m/s}^2$

$$t = l/|v_0| = 0.05 \text{ s}$$

$$y_E = 0.5a_y t^2 = 0.5 \text{ m}$$

$B \neq 0$: $r = \frac{mv}{QB} = 0.2 \text{ m}$

$$(r - y_B)^2 = r^2 - l^2, y_B = 0.2 \text{ m}$$

konec: $\Delta = 0.5 + 0.2 = \underline{\underline{0.7 \text{ m}}}$

2. Za desni zgornji vodnik:

$$\mathbf{f}_1 = \mathbf{1}_x IB_1 = \mathbf{1}_x \frac{\mu_0 I^2}{2\pi a}$$

$$\mathbf{f}_2 = \frac{\mathbf{1}_x + \mathbf{1}_y}{\sqrt{2}} IB_2 = \frac{\mathbf{1}_x + \mathbf{1}_y}{\sqrt{2}} \frac{\mu_0 I^2}{2\pi a\sqrt{2}}$$

$$\mathbf{f}_3 = -\mathbf{1}_y IB_3 = -\mathbf{1}_y \frac{\mu_0 I^2}{2\pi a}$$

$$\mathbf{f} = \sum_i \mathbf{f}_i = \underline{\underline{2 \cdot 10^{-4} (\mathbf{1}_x 3 - \mathbf{1}_y) \text{ N}}}$$

3. $\phi = \int \mathbf{B} \cdot d\mathbf{A} \Rightarrow \frac{\phi}{l} = \int B \cdot dx$

ϕ_0/l = prispevek polnega vodnika

ϕ_1/l = prispevek votline

$$\phi_0/l = \int_0^{r_0} (\mu_0 \frac{J}{2}) dx + \int_{r_0}^{2r_0} \frac{\mu_0 I_0}{2\pi x} dx = \mu_0 \frac{J}{4} r_0^2 + \frac{\mu_0 J \pi r_0^2}{2\pi} \ln \frac{2r_0}{r_0}$$

$$\phi_1/l = \int_{r_0/2}^{5r_0/2} \frac{\mu_0 I_1}{2\pi x} dx = \frac{\mu_0 J \pi (r_0/4)^2}{2\pi} \ln \frac{5r_0/2}{r_0/2}$$

$$\phi = (\frac{\phi_0}{l} - \frac{\phi_1}{l}) \cdot l = \mu_0 J l (\frac{r_0^2}{4} + \frac{\pi r_0^2}{2\pi} \ln 2 - \frac{\pi (r_0/4)^2}{2\pi} \ln 5) = \underline{\underline{1.1 \cdot 10^{-5} \text{ Vs}}}$$

4. $L_1 = \frac{N_1 \phi_1}{I_1}, R_i = \frac{l_i}{\mu_i A_i}$

$$I_1 N_1 = R_m \phi_1 \Rightarrow L = \frac{N_1^2}{R_m}$$

$$R_m = R_1 + \frac{R_2 R_3}{R_2 + R_3} = \frac{l_1 + \frac{l_2 l_3}{l_2 + l_3}}{\mu A}$$

$$L_1 = \frac{N_1^2 \mu A}{l_1 + \frac{l_2 l_3}{l_2 + l_3}} = \underline{\underline{\frac{1}{12} \text{ H}}}$$

5. $F = 2 \cdot \frac{B^2}{2\mu_0} A$

$$IN = Hl \Rightarrow H = \frac{IN}{2\pi r_s}$$

$$F = 2 \cdot \frac{1}{2\mu_0} (\frac{\mu IN}{2\pi r_s})^2 h^2 \approx \underline{\underline{1800 \text{ N}}}$$