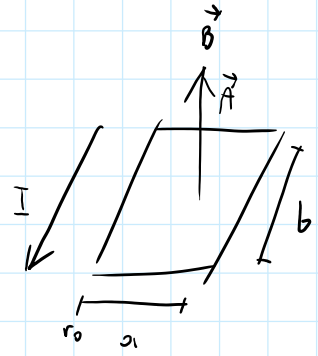
Ćwiczenia 10

wtorek, 11 grudnia 2018 11:16

LISTA 9

(1) $I = 100A$ $\quad r_0 = 10\,mm$ $\quad a = 30\,mm$ $\quad b = 50\,mm$



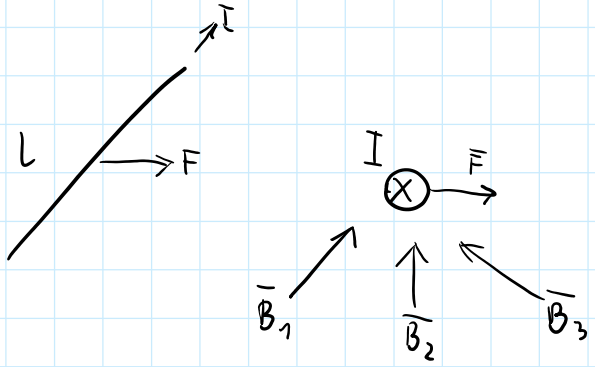
$\vec{A}$ - wektor normalny powierzchni

$\vec{B}$ - wektor indukcji

$$\Phi = \iint_S \vec{B}\,d\vec{S} = \iint_S \vec{B}\,ds\cos\alpha =$$

$$\int_{r_0}^{r_0+a} \frac{\mu_0 I}{2\pi r} b\,dr = \frac{\mu_0 I}{2\pi}\int_{r_0}^{r_0+a} \frac{1}{r}\,dr = \frac{\mu_0 I}{2\pi}\ln\frac{r_0+a}{r_0} = \frac{\mu_0 100}{2\pi}\ln\frac{r_0+a}{r_0}$$

(2)



$l = 10\,cm$ $\quad I = 100A$ $\quad F = 12\,N \approx 1{,}22\,kG$

$B = ?$ $\quad H = ?$

$\alpha = 90°$

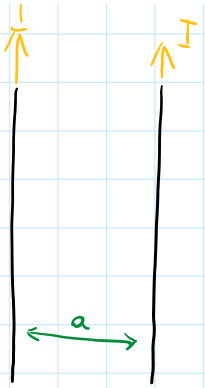
$\vec{F} = \vec{B} \times \vec{I}$ $\quad F = BI\sin\alpha$ $\quad F = BIl$ $\quad B = \frac{F}{Il}$

$d\vec{F} = J\vec{B} \times d\vec{l}$ $\quad \mu H = \frac{F}{Il}$ $\quad H = \frac{F}{Il\mu}$

(3)

$\mu_0 I^2 l$

(3)



$$F_m = \frac{\mu_0 I^2 l}{2\pi a}$$

$$F_m' = \frac{\mu_0 I^2}{2\pi a}$$

$$F_s = \frac{Q_l^2}{\varepsilon_0 2\pi a}$$

$$\frac{Q_l^2}{\varepsilon_0 2\pi a} = \frac{\mu_0 I}{2\pi a} \rightarrow Q_l^2 = \frac{\mu_0 I^2}{2\pi a}$$

$$Q_l^2 = \varepsilon_0 \mu_0 I^2$$

$$Q_l = I\sqrt{\varepsilon_0 \mu_0}$$

$F_{el.}$ $F_{magn.}$

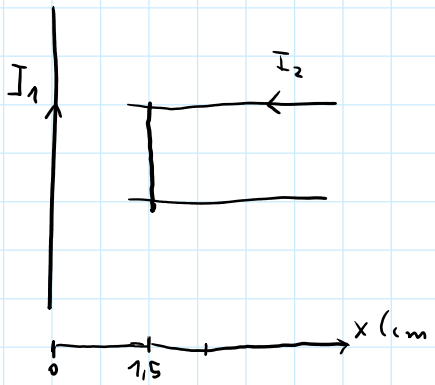
$$Q = \int \vec{D} \cdot d\vec{S} = \frac{Q_l^2}{\varepsilon_0 2\pi a} = \frac{\mu_0 I^2}{2\pi a} = 2\pi r l \cdot D$$

$$Q = Q_l \cdot l \rightarrow Q_l = D 2\pi r$$

$$Q_l = \varepsilon_0 E 2\pi r \rightarrow E = \frac{Q_l}{2\pi r \varepsilon_0}$$

$$U = \int E \cdot dr = \frac{Q_l}{2\pi\varepsilon_0} \int_{r_0}^{a} \frac{1}{r} dr = \frac{Q_l}{2\pi\varepsilon_0} \ln\left(\frac{a}{r_0}\right)$$

(4)



$I_1 = 50\,A \quad I_2 = 10\,A$

$F = ?$

$x_i = 1{,}5\,cm$

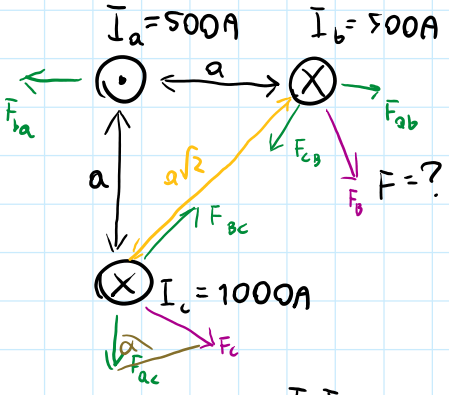
$x_f = 16{,}5\,cm$

$$F = \frac{\mu_0 I_1 I_2 l}{2\pi x}$$

$$W = \int_{1,5}^{16,5} \vec{F}\, d\vec{x} = \int_{1,5}^{16,5} \frac{\mu_0 I_1 I_2 l}{2\pi x}\Big|_x = \frac{\mu_0 I_1 I_2 l}{2\pi} \int \frac{1}{x} dx = \frac{\mu_0 I_1 I_2}{2\pi} \ln\frac{16,5}{1,5} =$$

$$= 10^{-4} \ln 11 \approx 2{,}4 \cdot 10^{-4}$$

(5)



$a = b = 1m$

$$F_{ba} = I_b B_a = \frac{\mu_0 I_A I_B}{2\pi a}$$

$$F_{cB} = I_c B_b \frac{\mu_0 I_c I_b}{2\pi\sqrt{2}}$$

$F_{ab} = 0,05 \qquad F_{ac} = 0,1$

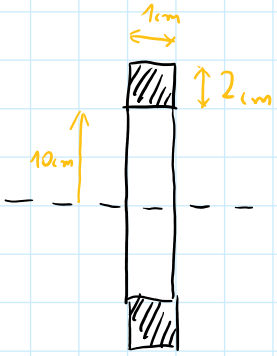
$$F_{ca} = I_c B_a = \frac{\mu_0 I_a I_c}{2\pi b}$$

$$F_a = \sqrt{F_{ab}^2 + F_{ca}^2}$$

$$F_A = F_{ac}^2 + F_{cB}^2 - 2F_{ac}F_{cb}\cos 90° = 0$$

$$F_B = F_{AB}^2 + F_{cB}^2$$

(6)



$z = 2000$
$I = 0,1A$
$B = ?$

$$H = \frac{nI}{2\pi r}$$

$$B_{2000} = \frac{\mu_0 I}{2\pi r} \cdot n = \frac{2000\mu I}{2\pi r}$$

$$\Phi = \int \vec{B}\, d\vec{S}$$

$$\Psi = n\Phi \qquad \Phi = B \cdot S$$

$$\Psi = B \cdot S \cdot n = \frac{2000\mu_0 I}{2\pi r} \cdot 2000$$