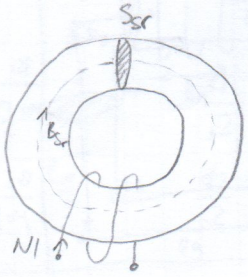
MAGNETSKI KRUGOVI

① jednak vektorski
② jednaka površina
③ jednak tok

Tekuća

3.7.



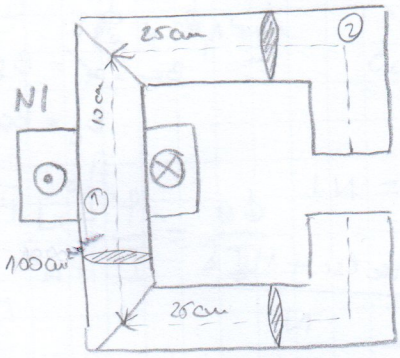
$$\oint_C \bar{H}\, d\bar{l} = \sum N_i I_i \quad \text{(Amperov kružni zakon)}$$

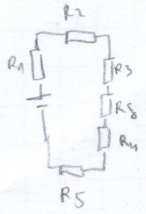
$$\Phi = B \cdot S$$

$$H_{sr} l_{sr} = NI$$

$$R_m = \frac{NI}{\Phi_{sr}} = \frac{H_{sr} l_{sr}}{B_{sr} S_{sr}} = \frac{1}{\mu} \frac{l_{sr}}{S_{sr}}$$

3.38





$B_\delta = 1\,T$
$I = 10\,A$
$N = ?$

$S_{Fe2} = S_\delta = 60\,cm^2$

$$\Phi_{Fe} = \Phi_\delta$$

$$B_\delta S_\delta = B_{Fe} S_{Fe2}$$

$B_\delta = B_{Fe} \rightarrow$ iz grafa očitamo $H_{Fe} = 200\,A/m$

a) $\Phi_{Fe} = \Phi_\delta$

$B_{Fe} S_{Fe2} = B_\delta S_\delta \quad S_{Fe2} = S_\delta$

$B_{Fe} = B_\delta$

$B_2 = 1T \rightarrow$ iz grafa $H_2 = 200\,A/m$

$B_\delta = \mu_0 H_\delta$

$$H_\delta = \frac{B_\delta}{\mu_0} = 7{,}958 \cdot 10^5\,A/m$$

$\Phi_1 = \Phi_2$

$B_1 S_1 = B_2 S_2$

$$B_1 = \frac{B_2 S_2}{S_1} = \frac{1 \cdot 60\,cm^2}{100\,cm^2} = 0{,}6\,T$$

$\rightarrow$ iz grafa $H_1 = 95\,A/m$

$H_1 l_1 + H_2 l_2 + H_\delta \delta = NI$

$l_1 = 10cm \quad l_2 = (25+25)cm$

$$N = \frac{H_1 l_1 + H_2 l_2 + H_\delta \delta}{I} = 1603$$

b) energija u raspom:

$$W = \frac{1}{2} \int_V \bar{B} \cdot \bar{H} \cdot dV, \quad dV = S_\delta \cdot \delta$$

$$W = \frac{1}{2} B_\delta H_\delta S_\delta \delta = 47{,}75\,J$$

c) μ_r dvije ploče dvoje 25 cm u radnoj točki gdje je $B_\delta = 1T$

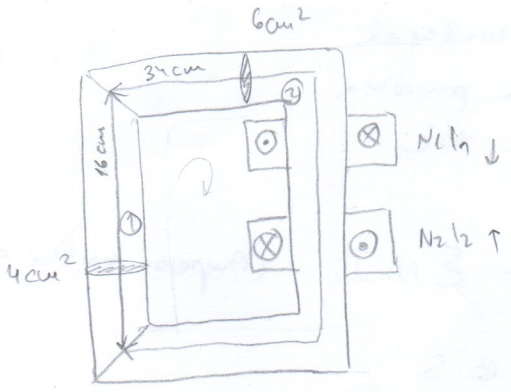
$B_2 = B_\delta = 1T \quad (H_2$ graf)

$\mu_0 \mu_r H_2 = B_\delta$

$$\mu_r = \frac{B_\delta}{H_2 \mu_0}$$

d)

B.39



$I_2 = 0{,}5\,A$

$N_1 = 200$

$N_2 = 100$

$\Phi = 120\,\mu Wb$

$I = 0{,}65\,A$

$\Phi = B_1 S_1 \Rightarrow B_1 = \frac{\Phi}{S_1}$ $\quad H_1 = \frac{B_1}{\mu_0 \mu_r}$ $\quad B_1 = 0.3T$ $\quad H_1 = 185$

$B_2 = \frac{\Phi}{S_2}$ $\quad H_2 = \frac{B_2}{\mu_0 \mu_r}$ $\quad B_2 = 0.2T$ $\quad H_2 = 145$

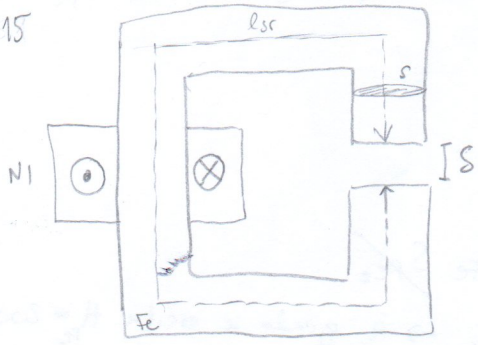
$\oint_C \bar{H}\, d\bar{l} = \sum NI$

$H_1 l_1 + H_2 l_2 = N_1 I_1 - N_2 I_2$

$I_1 = \frac{N_2 I_2 + H_1 l_1 + H_2 l_2}{N_1} = 0{,}65\,A$

$W_2 = \frac{1}{2} B_2 H_2 S_2 l_2$

B.115



$S = 3cm^2$

$l_{sr} = 25cm$

$\delta = 0.27mm$

$N = 280$

a) $B_{Fe} = 1{,}1\,T$

$\mu_r = 4000$

$I = ?$

$\oint_C \bar{H}\, d\bar{l} = NI$

$I = \frac{H_{Fe} l_{sr} + H_\delta \delta}{N}$

$\Phi_{Fe} = \Phi_\delta$

$B_{Fe} S_{Fe} = B_\delta S_\delta$

$B_\delta = B_{Fe}$

$H_\delta = \frac{B_\delta}{\mu_0} = \frac{B_{Fe}}{\mu_0}$

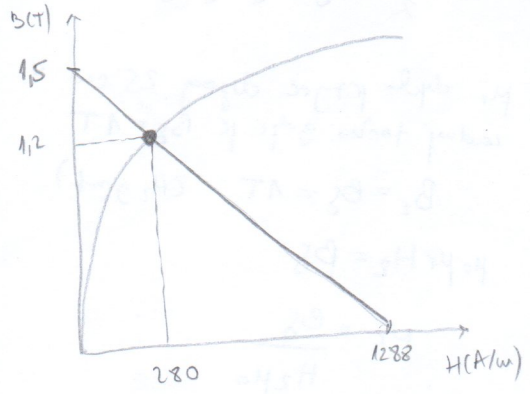
$H_{Fe} = \frac{B_{Fe}}{\mu_0 \mu_r}$

$I = \frac{\frac{B_{Fe}}{\mu_0}\left(\frac{l_{sr}}{\mu_r} + \delta\right)}{N} =$

B_δ

b) $I = 1{,}15\,A$

Grafoanalitičkom metodom odredite magnetsku indukciju u željeznoj jezgri grafa zadan



točka presjecišta iz grafa očitana:

$B_{Fe} = 1{,}2T$ $\quad H_{Fe} = 280\,A/m$

$B_{Fe} = \mu_0 \mu_r H_{Fe}$ $\quad \mu_r = \frac{B_{Fe}}{\mu_0 H_{Fe}}$

$B_\delta = \mu_0 H_\delta = \mu_0 \frac{NI}{\frac{l_{sr}}{\mu_r} + \delta}$

B_{Fe} iz ①

$\frac{B_{Fe}}{\mu_0 \mu_r} l_{sr} + \frac{B_\delta}{\mu_0} \delta = NI$

① $H_{Fe} l_{sr} + H_\delta \delta = N \cdot I$

$H_{Fe} l_{sr} + \frac{B_{Fe}}{\mu_0} \delta = N \cdot I$

točke presjecišta:

1) $H_{Fe} = 0$ $\quad 0 + \frac{B_{Fe}}{\mu_0} \delta = N \cdot I$

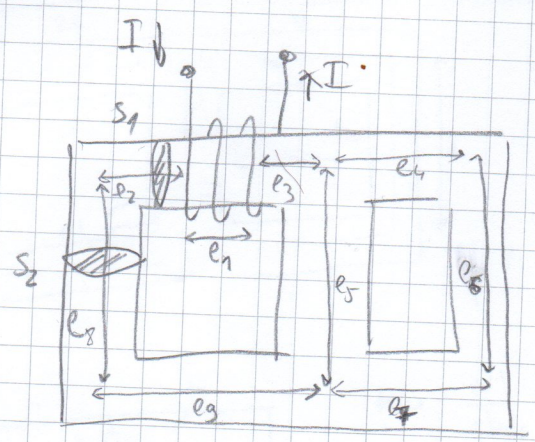
$B_{Fe} = \frac{NI\mu_0}{\delta} = 1{,}499\,T$

2) $B_{Fe} = 0$ $\quad H_{Fe} l_{sr} = NI$

$H_{Fe} = \frac{NI}{l_{sr}} = 1288\,A/m$

c) energija u zračnom zazoru:

$W = \frac{1}{2} \int \bar{B}\bar{H}\, dV = \frac{1}{2} B \cdot \frac{B}{\mu_0} dV = \frac{1}{2} \frac{B^2}{\mu_0} S \cdot \delta$



$l_3 = 0{,}04\,m$

$l_1 = l_2 = l_4 = l_7 = 0{,}05\,m$

$S_1 = 5 \cdot 10^{-4}\,m^2$

$S_2 = 10 \cdot 10^{-4}\,m^2$

$\mu = 1000\,\mu_0$

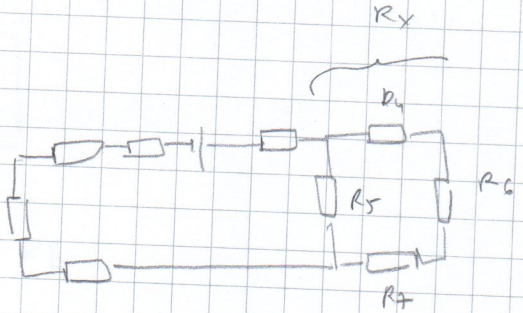
$l_9 = 0{,}14\,m$

$$L = \frac{\Psi}{I} = \frac{N\Phi}{I}$$

$$NI = \Phi R_m$$

$$\Phi = \frac{NI}{R_m}$$

$$L = \frac{N \cdot \frac{NI}{R_m}}{I} = \frac{N^2}{R_m}$$

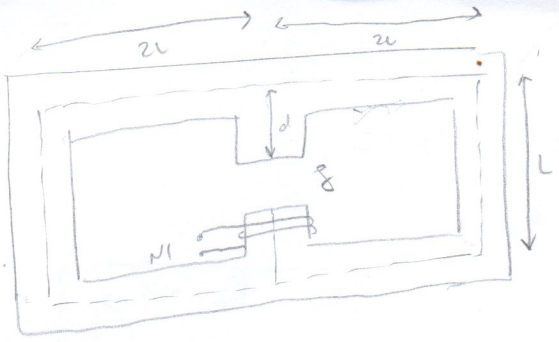


$$R_x = (R_4 + R_6 + R_7) \,||\, R_5$$

$$R_x = \frac{1}{\mu S_2}(l_4 + l_6 + l_7) \,||\, R_5$$

$$R_x = \frac{\frac{1}{\mu S_2}(l_4 + l_6 + l_7) \cdot \frac{1}{\mu S_2} l_5}{\frac{1}{\mu S_2}(l_4 + l_6 + l_7) + \frac{1}{\mu S_2} l_5} = \frac{\frac{1}{\mu S_2}(l_4 + l_6 + l_7)\, l_5}{l_4 + l_6 + l_7}$$

$$R = R_1 + R_2 + R_8 + R_9 + R_3 + R_x$$



$\delta = 0{,}2\,cm$ $\quad S = 20\,cm^2$

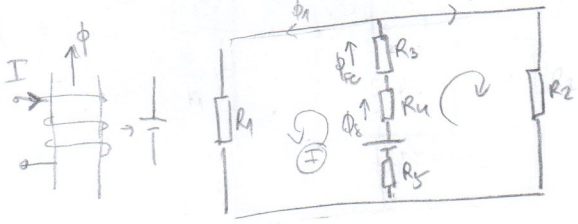
$d = \frac{L-\delta}{2}$ $\quad I = 0{,}1\,A$

$N = 250$

$L = 10\,cm = 0{,}1\,m$ $\quad L, B_\delta = ?$

$\mu_r = 1000$

a)



$$R_{uk} = \frac{NI}{\Phi_{sr}} = \frac{H_{sr} l_{sr}}{B_{sr} S_{sr}} = \frac{1}{\mu_r} \frac{l_{sr}}{S_{sr}}$$

$$L = \frac{N^2}{R_{uk}}$$

$R_1 = R_2$, $R_3 = R_5$, $R_\mu = R_\delta$

$$R_{uk} = R_1 \| R_2 + R_3 + R_\mu + R_5 = \frac{R_1}{2} + 2R_3 + R_\delta$$

$$R_1 = \frac{1}{\mu_0 \mu_r} \frac{l_{sr}}{S_s} = \frac{1}{\mu_0 \mu_r} \frac{5L}{S} = 198{,}94\,k\Omega$$

$$R_3 = \frac{1}{\mu_0 \mu_r} \frac{L-\delta}{2S} = 19{,}496\,k\Omega$$

$$R_5 = \frac{1}{\mu_0} \frac{\delta}{S} = 795{,}77\,k\Omega$$

$125 \cdot 10^6$

$R_{uk} = 937{,}23\,k\Omega$

$$L = \frac{N^2}{R_{uk}} = 66{,}9\,mH$$

b) $\Phi_{Fe} = \Phi_\delta$

$B_{Fe} S = B_\delta S$

$B_{Fe} = B_\delta$

$\Phi = \Phi_1 + \Phi_2$, $\Phi_1 = \Phi_2$

$\Phi = 2\Phi_1$

$B_{Fe} S = 2 B_1 S$

$B_{Fe} = 2B_1 = B_\delta$

$B_1 = \frac{B_\delta}{2}$

$\oint_c \vec{H}\, d\vec{l} = NI$

I. $H_1 \cdot 5L + H_{Fe}(L-\delta) + H_\delta \delta = NI$

$\frac{B_1}{\mu_0 \mu_r} 5L + \frac{B_{Fe}}{\mu_0 \mu_r}(L-\delta) + \frac{B_\delta}{\mu_0}\delta = NI$

$\frac{B_\delta}{2\mu_0 \mu_r} 5L + \frac{B_\delta}{\mu_r}(L-\delta) + \frac{B_\delta}{\mu_0}\delta = NI$

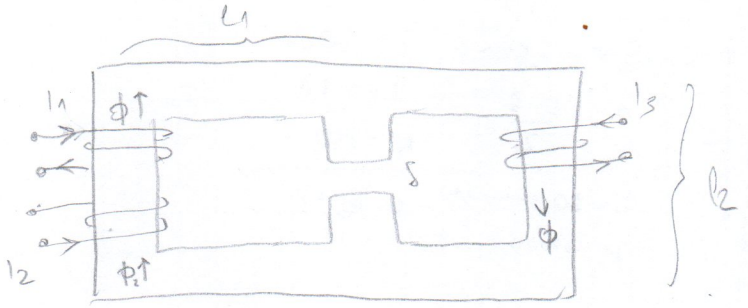
$$B_\delta = \frac{NI \cdot \mu_0}{\frac{5L}{2\mu_r} + \frac{L-\delta}{\mu_r} + \delta} = \frac{NI \cdot \mu_0}{\frac{7L-2\delta}{2\mu_r} + \delta}$$

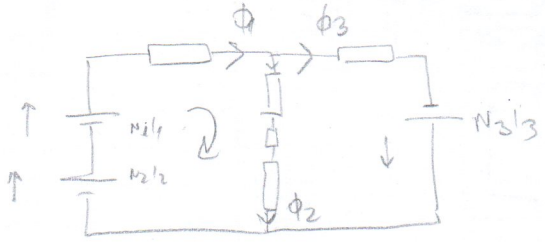
$B_\delta = 0{,}0134\,T$

→ tok u raspru se dijeli na 2 jednaka dijela

→ $\oint_c \vec{H}\, d\vec{l} = NI$ se gleda samo po jednoj konturi?

pr.





$$\oint_C \bar{H}\, d\bar{l} = \sum N_i I_i$$

$$H_1(2l_1 + l_2) + H_\delta\,\delta + H_2(l_2 - \delta) = N_1 I_1 + N_2 I_2$$

$$H_3(2l_1 + l_2) - H_\delta\,\delta - H_2(l_2 - \delta) = N_3 I_3$$

$$\Phi_1 = \Phi_2 + \Phi_3$$

$$B_1 = \frac{\Phi_1}{S_1}$$

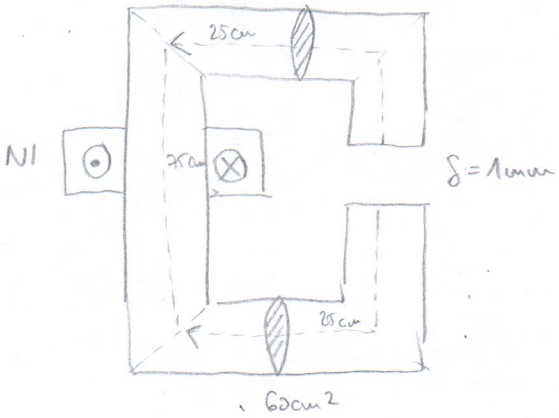
$$B_2 = \frac{\Phi_2}{S_2}$$

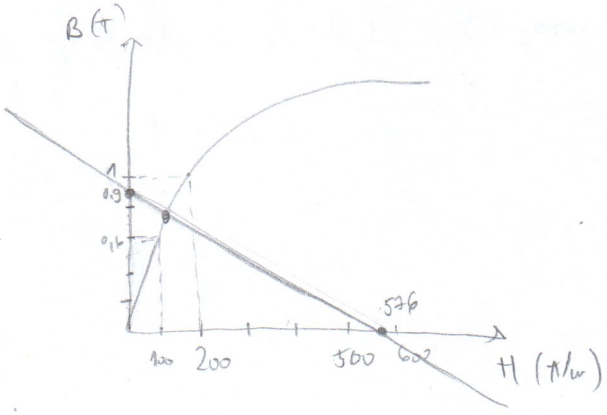
$$\Phi_2 = \Phi_\delta$$

$$B_2 = B_\delta$$

15/16

5.





$N = 50$, $I = 8A$, przejdź z uwagą ich

$B_\delta = ?$

$\Phi_{Fe} = \Phi_\delta$

$B_{Fe} S_{Fe} = B_\delta S_\delta$

$B_{Fe} = B_\delta$

$B = \mu H$

$H_\delta = \frac{B_\delta}{\mu_0} = \frac{B_{Fe}}{\mu_0}$

$\oint_c \bar{H}\, d\bar{l} = NI$

$H_{Fe}(0{,}25 \cdot 2 + 0{,}75) + H_\delta \cdot \delta = NI$

$H_{Fe} \cdot 1{,}25 + \frac{B_{Fe}}{\mu_0} \delta = NI$

graficzna metoda:

1) $H_{Fe} = 0$ $\quad \frac{B_{Fe}}{\mu_0} \delta = NI$

$B_{Fe} = \frac{NI\mu_0}{\delta} = 0{,}905\ T$

2) $B_{Fe} = 0$ $\quad H_{Fe} \cdot 1{,}25 = NI$

$H_{Fe} = \frac{NI}{1.25} = 576\ A/m$

tocka pracy:

$B_{Fe} = 0{,}7\ T$

$H_{Fe} = 125\ A/m$

$B_\delta = B_{Fe}$