① $\alpha = 23°$ $\quad q = p$

$B = 2{,}6\ mT$

$F_M = 6{,}5 \cdot 10^{-17}\ N$

---

a) $v = ?$ b) $E_k = ?$ [eV]

$F_M = q(\vec{v} \times \vec{B}) = qvB \sin\alpha \Rightarrow v = \frac{F_M}{qB\sin\alpha} = \frac{F_M}{eB\sin\alpha}$

$v = 4 \cdot 10^5\ m/s$

$E_k = \frac{1}{2} m_p v^2 = 1{,}34 \cdot 10^{-16}\ J$

$E_k = 1{,}34 \cdot 10^{-16} / 1{,}62 \cdot 10^{-19} = 835\ eV$ $\quad * 1 J \rightarrow eV$

② $\vec{v} = (2 \cdot 10^6\ m/s)\hat{i} + (3 \cdot 10^6\ m/s)\hat{j}$

$\vec{B} = (0{,}03\ T)\hat{i} - (0{,}15\ T)\hat{j}$

---

a) $\vec{F_M} = ?$ za elektron $\Rightarrow q = -e$

b) $\vec{F_M} = ?$ za proton $\Rightarrow q = +e$

$\vec{F_m} = q(\vec{v} \times \vec{B})$

$$q(\vec{v} \times \vec{B}) = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 \cdot 10^6 & 3 \cdot 10^6 & 0 \\ 0{,}03 & -0{,}15 & 0 \end{vmatrix} = \hat{k}\left[(2 \cdot 10^6 \cdot -0{,}15) - (0{,}03 \cdot 3 \cdot 10^6)\right] \cdot q$$

$\pm\ 1{,}6 \cdot 10^{-19} C$

a) $q = -e$

$\vec{F_M} = (6{,}2 \cdot 10^{-14}\ N)\hat{k}$

b) $q = e$

$\vec{F_M} = (-6{,}2 \cdot 10^{-14}\ N)\hat{k}$

(3) $\vec{B} = B_x \hat{i} + 3B_x \hat{j}$ $\quad \vec{F}_H = (6{,}4 \cdot 10^{-19}\,N)\,\hat{k}$

$\vec{v} = (2\hat{i} + 4\hat{j})\ m/s$

$q = e$

$B_x = ?$

$$\vec{F}_H = q\,\underbrace{(v_x B_y - v_y B_x)}\,\hat{k} = q\,(v_x 3B_x - v_y B_x)\,\hat{k}$$

REZ. VEKTORSKOG PRODUKTA $\vec{v} \times \vec{B}$ ZA OVAJ SLUČAJ

$$F_H = B_x q\,(3v_x - v_y) \Rightarrow B_x = \frac{F_H}{q(3v_x - v_y)} = \frac{6{,}4 \cdot 10^{-19}}{-1{,}6 \cdot 10^{-19}\,(3 \cdot 2 - 4)} = -2\,T$$

(4) $q = -2e$

$m_\alpha = 4u = 1{,}66 \cdot 10^{-27}\,kg$

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

$B = 1{,}2\,T$

$v, T, E_k, \Delta V = ?$

$F_H = F_{cp}$ — ULOGU CENTRIPETALNE SILE IMA MAGNETSKA SILA

$$|q|vB = \frac{mv^2}{r}$$

a) $qB = \frac{mv}{r} \Rightarrow v = \frac{qBr}{m_\alpha} = 2{,}6 \cdot 10^6\ m/s$

b) $T = \frac{2r\pi}{v} = 1{,}09 \cdot 10^{-7}\ s$

c) $E_k = \frac{1}{2} m_\alpha v^2 = 1{,}4 \cdot 10^5\ eV$

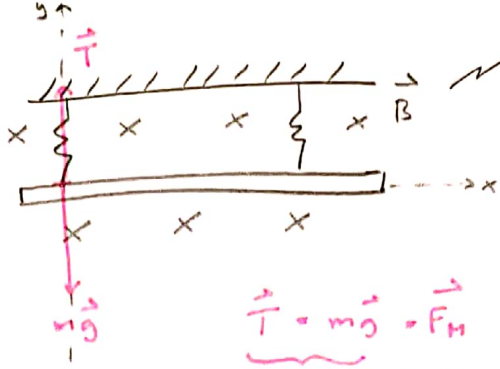
d) $\Delta V = \frac{E_k}{q} = 7 \cdot 10^4 V$

(5) $L = 62\ cm = 0{,}62\ m$

$m = 13\ g = 13 \cdot 10^{-3}\ kg$

$B = 0{,}44\ T$

$\vec{I} = ?$



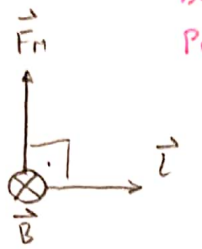
$\vec{T} - m\vec{g} - \vec{F}_M$

BEZ POLJA $\vec{B}$ — SA POLJEM $\vec{B}$

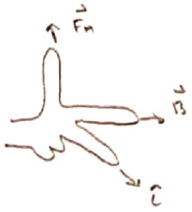
$mg = BiL$

$\Rightarrow i = \frac{mg}{LB} = 0{,}467\ A$

$\vec{i} = 0{,}467\ \hat{i}$



POMOĆU PRAVILA LIJEVE RUKE ODREDITE MEĐUSOBNI ODNOS VEKTORA $\vec{F}_M$, $\vec{B}$ i $\vec{i}$



(6) $L = 50\ cm = 0{,}5\ m$

$\vec{I} = 0{,}5\ A\ \hat{i}$

$\vec{B} = (3\hat{j} + 10\hat{k})\ mT$

$\vec{F}_M = ?$

$\vec{F}_M = i\vec{L} \times \vec{B} = iL\hat{i} \times (B_y\hat{j} + B_z\hat{k}) = iL(-B_z\hat{j} + B_y\hat{k})$

$= 0{,}5A \cdot 0{,}5m\ \{-0{,}01\ T\hat{j} + 0{,}003\ T\hat{k}\}$

$= (-2{,}5 \cdot 10^{-3}\hat{j} + 0{,}75 \cdot 10^{-3}\hat{k})\ N$

(7) $L = 13{,}1\ cm = 0{,}131\ m$

$R = 9{,}26\ cm = 9{,}26 \cdot 10^{-2}\ m$

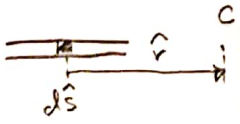
$I = 34{,}8\ mA = 34{,}8 \cdot 10^{-3}\ A$

$B_c = ?$

$dB = \frac{\mu_0 I}{4\pi} \cdot \frac{ds \sin\theta}{r^2}$

INDUCIRANA dB JEDNOG KOMADIĆA ŽICE ds STVARA U TOČKI UDALJENOJ ZA r ZBOG TOGA ŠTO NJIME TEČE STRUJA JAKOSTI I, KUT θ ZATVARAJU RADIJVEKTOR $\hat{r}$ i $d\hat{s}$

LIJEVA STRANA:



$d\hat{s} \parallel \hat{r} \Rightarrow \theta = 0 \Rightarrow dB = 0$

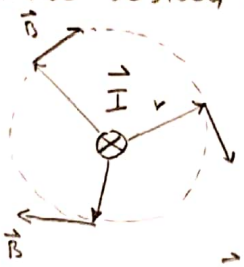
$\int dB = B_c = 0$

DESNA STRANA ZBOG SIMETRIJE JEDNAKA!

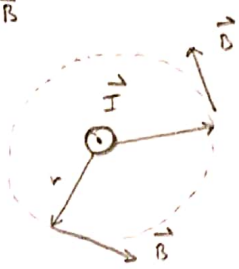
INDUKCIJA MAG. POLJA U SREDIŠTU POLUKRUŽNE PETLJE:

$B_c = \frac{\mu_0 I}{4R} = 1{,}18 \cdot 10^{-7}\ T$

PRAVILO DESNOG VIJKA:



SMJER STRUJE U PAPIR!



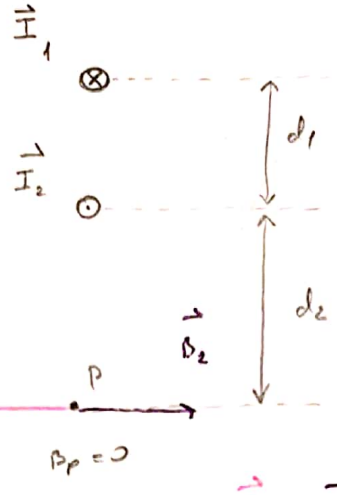
SMJER STRUJE IZ PAPIRA!

(8) $d_1 = 0{,}75\ cm = 0{,}75 \cdot 10^{-2}\ m$

$d_2 = 1{,}5\ cm = 1{,}5 \cdot 10^{-2}\ m$

$I_1 = 6{,}5\ A$

$I_2 = ?$



$B_P = 0$

$\vec{B}_1 + \vec{B}_2 = 0 - B_P$

$B = \frac{\mu_0 I}{2\pi R}$

↓

UDALJENOST OD ŽICE DO TOČKE U KOJOJ RAČUNAMO/MJERIMO INDUKCIJU B

$B_1 = \frac{\mu_0 I_1}{2\pi (d_1 + d_2)}$ $\quad B_2 = \frac{\mu_0 I_2}{2\pi d_2}$ $\quad \Rightarrow \quad \frac{\mu_0 I_1}{2\pi (d_1+d_2)} = \frac{\mu_0 I_2}{2\pi d_2}$

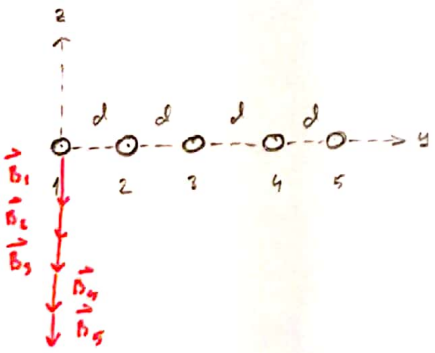
$$\frac{I_1}{d_1 + d_2} = \frac{I_2}{d_2}$$

$$\Rightarrow I_2 = \frac{d_2}{d_1 + d_2} I_1$$

$$I_2 = 4{,}3\ A$$

(1) $d = 8\ cm$ $\quad I = 3\ A$

$l = 10\ m$ $\quad \vec{F}_1, \vec{F}_2, \vec{F}_3, \vec{F}_4, \vec{F}_5 = ?$



SVAKA ŽICA STVARA OKO SEBE MAGNETSKO POLJE INDUKCIJE B; SVAKA ŽICA OSJETI DJELOVANJE MAGNETSKE SILE F_M JER SE NALAZI U POLJU DRUGIH ŽICA:

$F_M = \frac{\mu_0 I^2 l}{2\pi R}$ → DULJINA ŽICE

→ UDALJENOST DRUGIH ŽICA OD ŽICE KOJA OSJETI SILU F_M

SMJER $\vec{B}$ ODREĐUJETE PRAVILOM DESNOG VIJKA!

SMJER $\vec{F}$ ODREĐUJETE PRAVILOM DESNE RUKE!

SILA NA ŽICU 1

$$\vec{F}_1 = \frac{\mu_0 I^2 \ell}{2\pi} \cdot \left(\frac{1}{d} + \frac{1}{2d} + \frac{1}{3d} + \frac{1}{4d} \right) \hat{j} = \frac{25\,\mu_0 I^2 \ell}{24\pi d} \hat{j} = 4{,}69 \cdot 10^{-4}\ \mathrm{N}\,\hat{j}$$

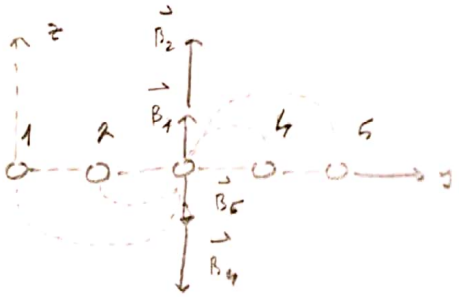
SILA NA ŽICU 2

DOPRINOSI OD ŽICA 1 I 3 SE ZBOG SIMETRIJE UKINU!

$$\vec{F}_2 = \frac{\mu_0 I^2 \ell}{2\pi} \left(\frac{1}{2d} + \frac{1}{3d} \right) \hat{j} = \frac{5\mu_0 I^2 \ell}{12\pi d} \hat{j} = 1{,}88 \cdot 10^{-4}\ \mathrm{N}\,\hat{j}$$

SILA NA ŽICU 3

$\vec{F}_3 = 0$ JER JE $\vec{B}$ U TOČKI 3 NULA!



SILA NA ŽICU 5 $\vec{F}_5 = -\vec{F}_1$

SILA NA ŽICU 4 $\vec{F}_4 = -\vec{F}_2$

(10) $r = 2\,\mathrm{cm}$

$a = 0\,\mathrm{cm},\ 1\,\mathrm{cm},\ 2\,\mathrm{cm}$

$I = 130\,\mathrm{A}$

$B = ?$

B UNUTAR ŽICE: $B_u = \frac{\mu_0 I a}{2\pi r^2}$ $\rightsquigarrow$

$a = 0$ $B = 0$

$a = 1\,\mathrm{cm}$ $B = 6{,}5 \cdot 10^{-4}\,\mathrm{T}$

$a = 2\,\mathrm{cm}$ $B = 1{,}3 \cdot 10^{-3}\,\mathrm{T}$

B IZVAN ŽICE: $B_i = \frac{\mu_0 I}{2\pi r}$