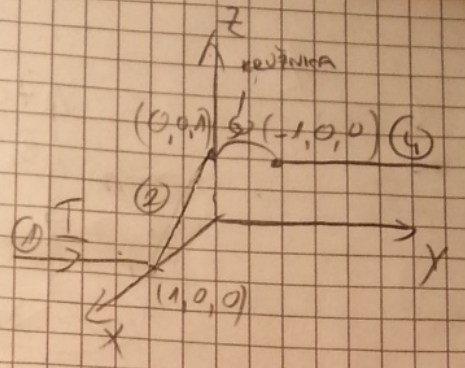
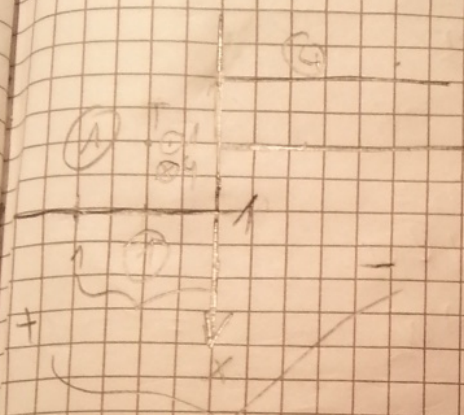
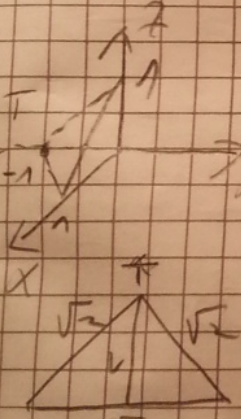
① T(0,1,0)
I = 1√2,7 A





$$\vec{B}_{14} = \vec{a}_z \frac{\mu_0 I}{4\pi \cdot 1}(\sin 45^\circ + \sin 45^\circ) = \vec{a}_z \frac{\mu_0 I}{4\pi}\sqrt{2}$$

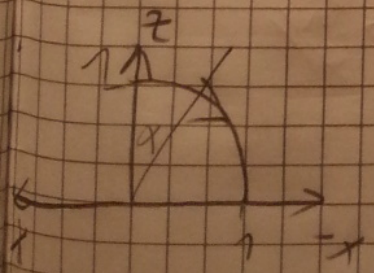
SEGMENT ②



$$\vec{B}_2 = \frac{\mu_0 I}{4\pi \cdot \sqrt{2}}(\sin 30^\circ + \sin 30^\circ)\left(\vec{a}_y - \vec{a}_y + \vec{a}_z\right)\frac{1}{\sqrt{3}}$$

$$= \frac{\mu_0 I \sqrt{2}}{4\pi 3}\left(\vec{a}_x - \vec{a}_y + \vec{a}_z\right)$$

SEGMENT ③



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$$\vec{B}_{os} = -\vec{a}_y B_{os} = \frac{\mu_0 I}{2}\frac{r_0^2}{(r_0^2+y^2)^{3/2}}\cdot\frac{1}{4} - \frac{\mu_0 I}{(1+1)^{3/2}}\cdot\frac{1}{8}(-\vec{a}_y)$$

$$\vec{B}_{pod} = \frac{\mu_0 I r_0 \cdot |dl|}{4\pi(r_0^2+y^2)^{3/2}}\int_{\alpha=0}^{\pi/2}(\cos\alpha\,\vec{a}_z - \sin\alpha\,\vec{a}_x)\,d\alpha$$

$$= \frac{\mu_0 I}{8\pi\sqrt{2}}\left[\vec{a}_z - \vec{a}_x\right]$$

$$\vec{B} = \vec{B}_{14} + \vec{B}_2 + \vec{B}_3 = \mu_0 I\left[\left(\frac{\sqrt{2}}{12\pi} - \frac{1}{8\pi\sqrt{2}}\right)\vec{a}_x + \left(-\frac{\sqrt{2}}{12\pi} - \frac{1}{16\sqrt{2}}\right)\vec{a}_y + \left(\frac{\sqrt{2}}{4\pi} + \frac{\sqrt{2}}{12\pi} + \frac{1}{8\pi\sqrt{2}}\right)\vec{a}_z\right]$$

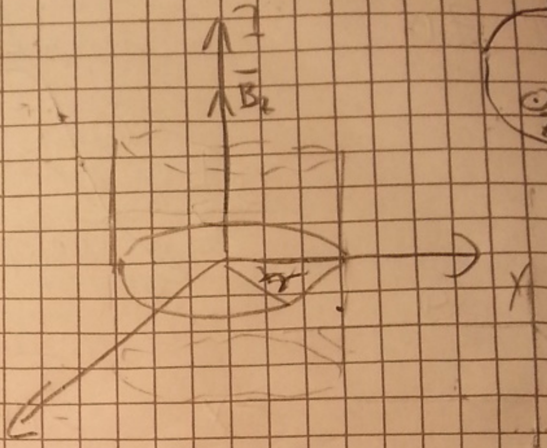
(2) $\bar{B} = k \cdot B_0 \cdot t \cdot \bar{a}_z$

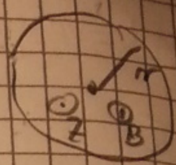
$B_0 = 2\,T$

$k = 1{,}5\ s^{-1}$

$T(r = 1,\ \alpha = 30°,\ z = 2)$

$t = 2\,s$





$$\oint \bar{A}\cdot d\bar{l} = \iint_S \bar{B}\cdot\bar{n}\,dS$$

$d\bar{l} = dl\,\bar{a}$

$\bar{A} = A\,\bar{a}_\alpha$

$$A = \frac{Br}{2} = \frac{k B_0 r t}{2}$$

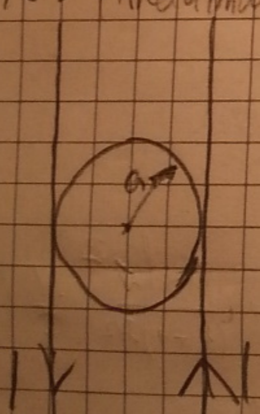
$A \cdot 2\pi r_0 = B r^2 \pi$

$$A = \frac{1{,}5 \cdot 2 \cdot 1 \cdot 2}{2} = 3\,Tm$$

(3) $I = 5\,A$

$d = 2a = 3\,m\ (a = 1{,}5\,m)$

$M = ?$ (međuinduktivitet)



$$M = \frac{\Phi_u}{I} = \frac{2\Phi_1}{I}$$

$(x-a)^2 + y^2 = a^2$ $dS = 2 \cdot y\,dx$

$$\Phi = \frac{\mu_0 I}{2\pi} \cdot 2 \int_{x=0}^{2a} \frac{\sqrt{a^2-(x-a)^2}}{x}\,dx = \mu_0 I a$$

$$M = 2M_1 = 2\,\frac{\mu_0 I a}{I} = 2\mu_0 a$$

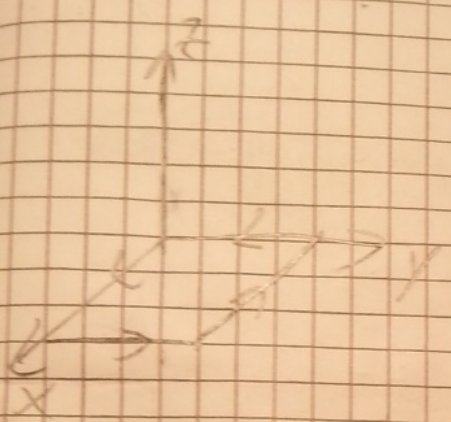
4) $H = \frac{1}{2\pi + 4} a_r$

$\nabla \times \bar{H} = \bar{J}$

$\bar{I} = \int_S \bar{J} \bar{n} dS$

$I = \frac{1}{m_2} = 0,083$ [=83 mA]

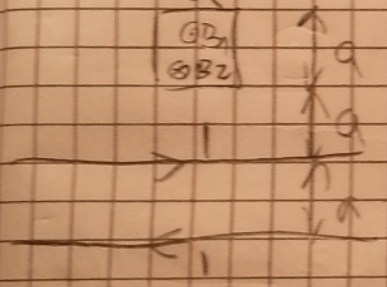
=>

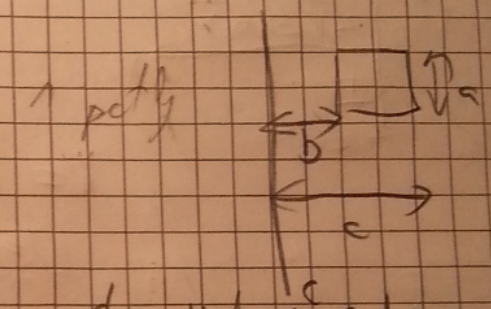


5) $R = 1$

$= 10 \cos(314t) A$

$L = 1 H$





$\phi = \frac{\mu_0 I}{2\pi} \int_b^c \frac{a\,dx}{x}$

$= \frac{\mu_0 I}{2\pi} a \ln \frac{c}{b}$

$\phi_{12} = \frac{\mu_0 I}{2\pi} a \left[\ln \frac{2a}{a} - \ln \frac{3a}{2a} \right] = \frac{\mu_0 I a}{2\pi} \underbrace{\left[\ln 2 - \ln \frac{3}{2} \right]}_{0,287}$

$\phi(i) = \frac{\mu_0 a}{2\pi} \ln\left(\frac{4}{3}\right) \cdot i(t)$

$e = -\frac{d\phi}{dt} = -\frac{\mu_0 a}{2\pi} \cdot \ln\left(\frac{4}{3}\right) \cdot 10 \cdot 314 \cdot [-\sin(314t)]$

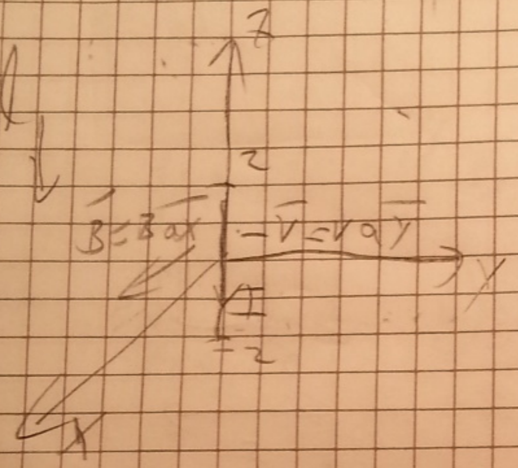
$|i| = \left| \frac{e}{4R} \right|$

$I_{max} = \frac{\mu_0 a \ln\left(\frac{4}{3}\right)}{2\pi} \cdot 10 \cdot 314 \cdot \frac{1}{4R} = 45 \mu A$

⑥ Vodič leži u osi z za $-2 \le z \le 2$ [m] $I = 2(-a_z)$ [A]

$\vec{B} = 2 \cdot 10^{-3} e^{-0,1y} \vec{a}_x$ [T]

Odrediti iznos F (mJ) koji je potreban za pomak vodiča konst. brzinom za 1m u smjeru a_y.



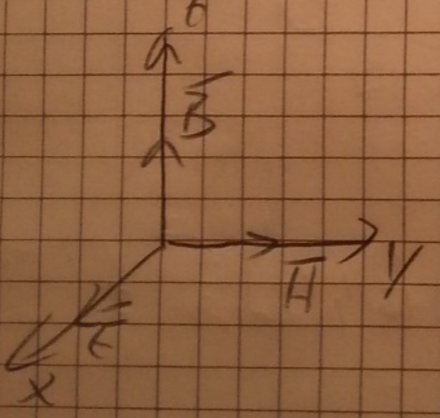
$\vec{F} = I\,\vec{l} \times \vec{B}$

$\vec{F} = -\vec{a}_z \cdot 2 \cdot 4 \cdot 2 \cdot 10^{-3} e^{-0,1y} = \vec{F}(y)$

$W = \int_{y=0}^{1} \vec{F} \cdot d\vec{l} = \int_{y=0}^{1} -16 \cdot 10^{-3} e^{-0,1y} \, dy$

$W = 0,0152 \text{ J} = 15,2 \text{ mJ}$

⑦ U vakuumu je el. polje zadano jednadžbom: $\vec{E}(z,t) = 20\cos(\omega t - \beta z)$ ...
Odrediti srednju snagu u [W] koja prolazi kroz polukrug 2m u ravnini ...



$H = \frac{E}{Z} = \frac{20}{120\pi}$

↳ srednja $\cos^2$

$N_{sr} = \frac{E^2}{Z} \cdot \frac{1}{2} = \frac{400}{120\pi} \cdot \frac{1}{2}$

$P = N_{sr} \cdot S = \frac{400}{120\pi} \cdot \frac{1}{2} \cdot 2^2 \pi = 6,67$ [W]

8) Odredite iznos jakosti el. polja $|\vec{E}|$ u $t=0$, $x=0{,}8\,\lambda$ [m] na vrhu vektora $\vec{E}$ [V/m] zadanog jednadžbom: $\vec{E}(x,t) = 12\sin(\omega t - \beta x)\vec{a}_y - 16\sin(\omega t - \beta x)\vec{a}_z$

$$\beta = \frac{2\pi}{\lambda} \qquad x\beta = 0{,}8\,\lambda \cdot \frac{2\pi}{\lambda} = 1{,}6\pi$$

$$\vec{E} = 12\sin(-1{,}6\pi)\vec{a}_y + 16\sin(-1{,}6\pi)\vec{a}_z = -11{,}4\vec{a}_y - 15{,}2\vec{a}_z$$

$$E = \sqrt{E_y^2 + E_z^2} = 19 \text{ V/m}$$ (3)

9) U sredstvu relativne permabilnosti $\mu_r = 1$ jakost mag. polja:

$$\vec{H} = \frac{e^{-y}}{5}\cos(2\pi\cdot 10^8 t - 2y)\vec{a}_x \text{ [A/m]}.$$

Odredite jakost el. polja u [V/m] u $t = 0{,}02\,\mu s$, $y = 0{,}2$ m. NIJE RAVNI VAL.

$$\nabla \times \vec{H} = \frac{\partial \vec{D}}{\partial t}$$

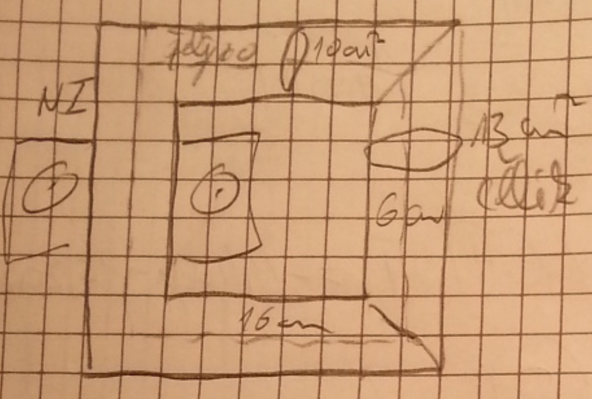
$$\nabla \times \vec{H} = \begin{vmatrix} a_x & a_y & a_z \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ H_x & 0 & 0 \end{vmatrix} = -\vec{a}_z \frac{\partial H_x}{\partial y} = -\frac{1}{5}\vec{a}_z\left[-e^{-y}\cos(\omega t - 2y) + 2e^{-y}\sin(\omega t - 2y)\right]$$

$$= \frac{\partial \vec{D}}{\partial t} \Big/ \int$$

$$\vec{E} = \frac{1}{5\varepsilon_0} e^{-y}\vec{a}_z \cdot \left(\frac{1}{\omega}\sin(\omega t - 2y) + \frac{2}{\omega}\cos(\omega t - 2y)\right)$$

$$\vec{E}(t = 0{,}02\,\mu s,\ y = 0{,}2\text{ m}) = 42{,}75\,\vec{a}_z \text{ [V/m]}$$ (4)

(10) Mag. krug na slici. Zadana je mag. indukcija u željezu iznosa 1,3 T i broj zavoja $N = 85$. Odredite iznos struje u [A] kroz zavojnicu



$\Phi_ž = \Phi_č$

iz TABLICE

$B_ž \cdot S_ž = B_č \cdot S_č$

$B_ž = 1,3\ T \Rightarrow H_ž = 800\ A/m$

$B_č = 1,3 \cdot \frac{S_ž}{S_č} = 1,3 \cdot \frac{10}{13} = 1\ T$

$H_č = 100\ A/m$

$\oint H\,dl = NI$

$NI = H_ž \cdot 0,16 + H_č \cdot 0,06 = 134$

$I = \frac{134}{85} \approx 1,6\ A$