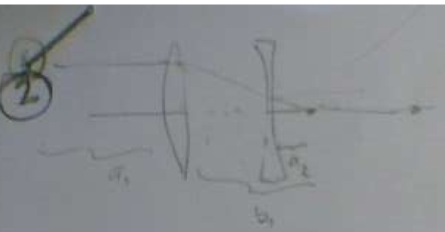
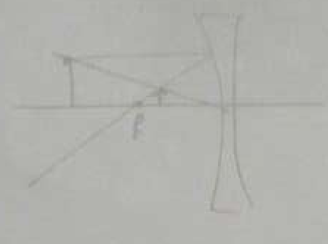
GEOM. OPTIKA

(2)



$f = 25\,cm$

$d = 15\,cm$



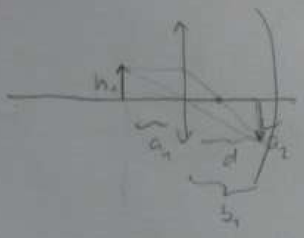
$a_1 = \infty$

$\frac{1}{a_1} + \frac{1}{b_1} = \frac{1}{f} \Rightarrow \frac{1}{b_1} = \frac{1}{25} - \frac{1}{\infty} \Rightarrow b_1 = 25\,cm$

$a_2 = 25\,cm - 15\,cm = -10\,cm$

$\frac{1}{a_2} + \frac{1}{b_2} = -\frac{1}{f} \qquad \frac{1}{b_2} = -\frac{1}{f} - \frac{1}{a_2} = -\frac{1}{25} + \frac{1}{10} = 0.06 \Rightarrow b_2 = +16.67\,cm$ s desne strane leće

(3)

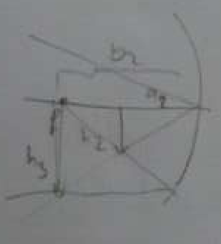


$h_1 = 1\,cm \quad a_1 = 6\,cm \qquad d = 20\,cm \qquad R = 8\,cm$

$\frac{1}{f_1} = 25\,m^{-1} \Rightarrow f_1 = 0.04\,m = 4\,cm \qquad \frac{1}{f_2} = \frac{2}{R} \Rightarrow f_2 = \frac{R}{2} = 4\,cm$

$\frac{1}{a_1} + \frac{1}{b_1} = \frac{1}{f_1} \Rightarrow b_1 = 12\,cm$

$a_2 = d - b_1 = 8\,cm$



$\frac{1}{a_2} + \frac{1}{b_2} = \frac{1}{f_2} \qquad b_2 = 8\,cm$

$a_3 = -(d - b_2) = -12\,cm$ udaljen od leće $d - b_2 = 15.93\,cm$ lijevo

$\frac{1}{a_3} + \frac{1}{b_3} = \frac{1}{f} \Rightarrow$ pomiro se do $f + 12$? $b_3 = 6\,cm \Rightarrow$ ali obrnuto desno i lijevo?

$m_1 = -\frac{b_1}{a_1} = -\frac{12}{6} = -2$

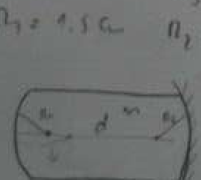
$m_2 = -\frac{b_2}{a_2} = -\frac{8}{8} = -1$

$m_3 = -\frac{b_3}{a_3} = \frac{6}{12} = -\frac{1}{2}$

$m_{uk} = m_1 m_2 m_3 = -1$

(8)

$R_1 = 1.5\,cm \quad R_2 = 6\,cm \quad d = 3\,cm \quad n = 1.5$



sferni diopter $\frac{n}{a} + \frac{n'}{b} = \frac{n' - n}{R}$

$\frac{1}{a_1} + \frac{n}{b_1} = \frac{n-1}{R_1}$

1° $\frac{1}{\infty} + \frac{1.5}{b_1} = \frac{1.5 - 1}{1.5} \Rightarrow b_1 = 4.5\,cm$

2° $a_2 = d - b_1 = -1.5\,cm \qquad R_2 = +6\,cm \qquad \frac{1}{a_2} + \frac{1}{b_2} = \frac{2}{R_2}$

zrcalo sferno $\frac{1}{-1.5} + \frac{1}{b_2} = \frac{2}{R_2}$ ✓

$-\frac{1}{1.5} - \frac{1}{b_2} = \frac{2}{6} \Rightarrow b_2 = 1\,cm$

3° ponovo pri diopter

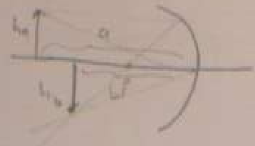
$a_3 = -(d - b_2) = -2\,cm \qquad R_1 = +1.5\,cm$

$\frac{1.5}{-2} + \frac{1}{b_3} = \frac{1 - 1.5}{1.5} \qquad \underline{b_3 = 2.4\,cm}$

$b_3 = 2.4\,cm$

(uzeto uz $R_1 = +1.5\,cm$ i $a_3 = 2\,cm$)

③



$$\frac{1}{a}+\frac{1}{b}=\frac{1}{f}$$

$$\frac{h_b}{h_a}=\frac{b}{a}$$

1° $\frac{1}{a}+\frac{1}{b}=\frac{1}{f}$ $\quad \frac{h_b}{h_a}=\frac{b}{a}=\frac{1}{4}$ $\quad \Rightarrow a=4b$

$\frac{1}{4b}+\frac{1}{b}=\frac{1}{f}$ $\quad \frac{5}{4}\frac{1}{b}=\frac{1}{f}$ $\quad b=\frac{5}{4}f$ $\quad a=5f$

2° $\frac{1}{a-5}+\frac{1}{c}=\frac{1}{f}$ $\quad \frac{h_c}{h_a}=\frac{c}{a-5}=\frac{1}{2}$ $\quad \Rightarrow a-5=2c$

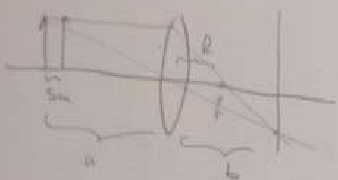
$\frac{1}{2c}+\frac{1}{c}=\frac{1}{f}$ $\quad \frac{3}{2}\frac{1}{c}=\frac{1}{f}$ $\quad c=\frac{3}{2}f$

$5f-5=3f \Rightarrow 2f=5$

$\underline{f=2.5\,cm}$

$a=12.5\,cm$

④



$b=300\,cm$

$f=50\,cm$

$\frac{1}{a}+\frac{1}{b}=\frac{1}{f} \Rightarrow \frac{1}{a}=\frac{1}{50}-\frac{1}{300} \Rightarrow a=60\,cm$

$\frac{1}{a-5}+\frac{1}{b'}=\frac{1}{f} \Rightarrow \frac{1}{b'}=\frac{1}{50}-\frac{1}{55} \Rightarrow b'=550\,cm$

$\underline{\underline{\Delta b=250\,cm}}$

⑤

$$\frac{1}{a}+\frac{1}{b}=\frac{1}{f}=\frac{2}{R}$$

$\frac{1}{b}=\frac{2}{R}-\frac{1}{a}=\frac{2a-R}{Ra}$ $\quad b=\frac{Ra}{2a-R} \;\Big/ \frac{d}{dt}$

$v_a=\frac{da}{dt}$

$v_b=\frac{db}{dt}$

$$v_b=\frac{db}{dt}=\frac{Rv_a(2a-R)-Ra\cdot 2v_a}{(2a-R)^2}=\frac{2aRv_a-R^2v_a-2aRv_a}{(2a-R)^2}$$

$$v_b=-\frac{R^2}{(2a-R)^2}\cdot v_a$$

$$v_b\Big|_{a=2R}=-\frac{R^2}{(4R-R)^2}v_a=-\frac{R^2}{9R^2}\cdot v_a=\underline{\underline{-\frac{v_a}{9}}}$$

⑥

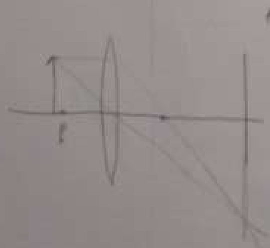
$a_1+b_1=1\,m$ $\quad l=25\,cm$

$\frac{1}{a_1}+\frac{1}{b_1}=\frac{1}{f}$ $\quad \frac{1}{a_1}+\frac{1}{1-a_1}=\frac{1}{f}$

$\frac{1}{a_2}+\frac{1}{b_2}=\frac{1}{f}$ $\quad \frac{1-a_1+a_1}{a_1(1-a_1)}=\frac{1}{f}$ $\quad f=a_1(1-a_1)$

$a_2=a_1\pm l$

1° $a_2=a_1-l$



$b_2=b_1+l=1-a_1+l$

$$\frac{1}{a_2}+\frac{1}{b_2}=\frac{1}{a_1-l}+\frac{1}{1-a_1+l}=\frac{1}{f}$$

$$\frac{1-a_1+l+a_1-l}{(a_1-l)(1-a_1+l)}=\frac{1}{f}$$

$f=(a_1-l)(1-a_1+l)$

$f=a_1(1-a_1)$

$\cancel{a_1}-l-\cancel{a_1^2}+la_1+la_1-l^2=\cancel{a_1}-\cancel{a_1^2}$

$l^2-2la_1+l=0$

$l(l-2a_1+1)=0$

$l-2a_1+1=0$ $\quad a_1=\frac{l+1}{2}=0.625$

$\underline{f=\frac{15}{64}}$

2° $a_2=a_1+l$

$b_2=b_1-l=1-a_1-l$

$$\frac{1}{a_2}+\frac{1}{b_2}=\frac{1}{a_1+l}+\frac{1}{1-a_1-l}=\frac{1}{f}$$

$\frac{1-a_1-l+a_1+l}{(a_1+l)(1-a_1-l)}=\frac{1}{f}$ $\quad f=(a_1+l)(1-a_1-l)$

$\cancel{a_1}-\cancel{a_1^2}=\cancel{a_1}+l-\cancel{a_1^2}-la_1-a_1l-l^2$

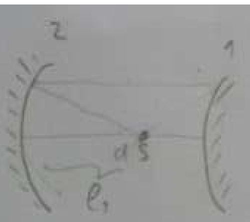
$0=l(1-2a_1-l)$

$1-2a_1-l=0$

$a_1=\frac{1-l}{2}=0.375$

$\underline{f=\frac{15}{64}}$

(7)



$d = 1\,m$ $R_2 = 80\,cm$ $\ell_1 = 65\,cm$ $\ell_2 = d - \ell_1 = 35\,cm$

$R_1 = ?$ $R_1 < 0$

$\frac{1}{a_1} + \frac{1}{b_1} = \frac{1}{f_2} = \frac{2}{R_2} \Rightarrow \frac{1}{+65} + \frac{1}{b_1} = \frac{2}{80}$ $b_1 = 104\,cm$

$a_2 = d - b_1 = -4\,cm$

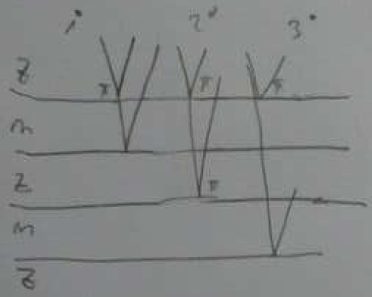
$\frac{1}{a_2} + \frac{1}{b_2} = \frac{1}{f_1} = \frac{2}{R_1} \Rightarrow \frac{1}{-4} + \frac{1}{+35} = \frac{2}{+R_1}$

$b_2 = +\ell_2 = +35$

$\underline{R_1 \approx -9\,cm}$

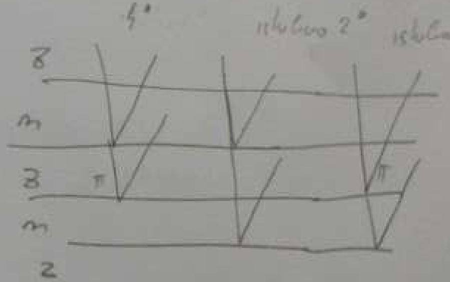
FIZIKALNA OPTIKA

(10)



konstruktivna za $\Delta\Phi = 2\pi$

- na mjestima dolazi za π



1° $\Delta\Phi = \pi + \frac{2\pi}{\lambda} \cdot 2dn = 2\pi$

$\underline{\lambda = 4dn = 561.6\,nm}$

2° $\Delta\Phi = \pi + \pi + \frac{2\pi}{\lambda} 2d + \frac{2\pi}{\lambda} \cdot 2dn = 2\pi + 2\pi$

$\frac{2\pi}{\lambda}(2d + 2dn) = 2\pi$

$\underline{\lambda = 2d + 2dn = 468\,nm}$

3° $\Delta\Phi = \pi + \frac{2\pi}{\lambda}(2d + 4dn) = 2\pi$

$\frac{2\pi}{\lambda}(2d + 4dn) = \pi$

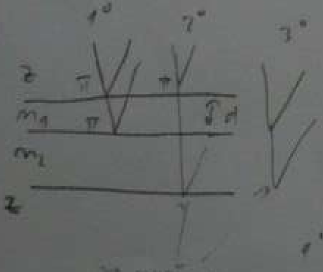
$\lambda = 2(2d + 4dn) = 1553.2\,nm$

- nije u vidljivom dijelu spektra

4° $\Delta\Phi = \pi + \frac{2\pi}{\lambda} 2d = 2\pi$

$\underline{\lambda = 4d = 360\,nm}$

(11)



u mantissi je manja dest. od n_1 sloja

$n_1 = 1.3$ $n_2 = 1.55$

$\Delta\phi = \pi$ za destruktivnu interferenciju

1° $\Delta\phi = \pi - \pi + \frac{2\pi}{\lambda} \cdot 2n_1 d = \pi$

$\lambda = 4 n_1 d \Rightarrow d = \frac{\lambda}{4n_1}$

(9) 

$r = 0.5\,mm$

$n = 1.6$

$a_1 = \infty$

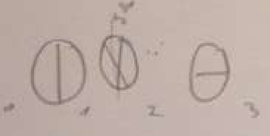
$$\frac{n}{a} + \frac{n'}{b} = \frac{n'-n}{R}$$

$$\frac{1}{\infty} + \frac{1.6}{b_1} = \frac{1.6-1}{0.5} \qquad b_1 = \frac{4}{3}\,mm = 1.333$$

$$a_2 = 1 - 1.333 = -\frac{1}{3} \qquad R_2 = -R_1 = -0.5\,mm$$

$$\frac{1.6}{a_2} + \frac{1}{b_2} = -\frac{1-1.6}{0.5} \Rightarrow b_2 = \frac{1}{6}\,mm = \underline{0.1667}\,m$$

(15)



$I = I_0 \cos^2\varphi$

$I_3 = ?$

$$I_1 = \frac{1}{2} I_0$$

$$I_2 = I_1 \cdot \cos^2(10^\circ)$$

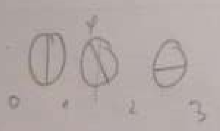
$$I_3 = I_2 \cdot \cos^2(80^\circ) \qquad I_3 = I_2 \cdot \cos^2(100^\circ)$$

$$= \frac{1}{2} I_0 \cos^2(10^\circ)\cos^2(80^\circ) \qquad -180^\circ \text{ ker je } \cos(100^\circ) = -\cos(80^\circ)$$

$$= 0.01162\, I_0$$

(14)

pod φ



a)
$$\left.\begin{aligned} I_1 &= I_0 \cos^2(\varphi) \\ I_2 &= I_1 \cos^2(\varphi) \\ I_3 &= I_2 \cos^2(90-\varphi) \end{aligned}\right\} I_3 = I_0 \cos^4(\varphi)\cos^2(90-\varphi)$$

b) $\varphi = ?$ t.d. je I_3 max

$$I_3 = I_0 \cos^4(\varphi)\sin^2(\varphi)$$

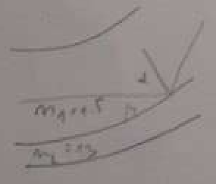
$$\frac{\partial I_3}{\partial \varphi} = I_0 \cdot 4 \cdot \cos^3(\varphi) \cdot (-\sin\varphi) \cdot \sin^2\varphi + I_0 \cos^4\varphi \cdot 2\sin\varphi \cdot \cos\varphi =$$

$$= 2I_0 \left(-2\cos^3\varphi \sin^3\varphi + \cos^5\varphi \sin\varphi\right) = 2 I_0 \cos^5\varphi \sin\varphi \left(1 - 2\,tg^2\varphi\right)$$

1° $\cos\varphi = 0 \Rightarrow \varphi = \frac{\pi}{2}$

2° $1 - 2\,tg^2\varphi = 0 \qquad tg^2\varphi = \frac{1}{2} \qquad \varphi = \underline{35.26^\circ}$ c) enako za $\varphi = 35.26^\circ$

(12)



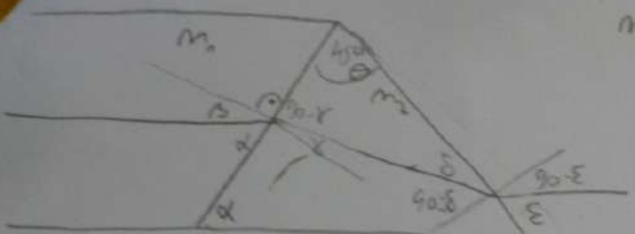
totalna refleksija

$$\frac{\sin\alpha}{\sin\alpha'} = \frac{n'}{n} \qquad \sin\alpha = \frac{n'}{n} = \frac{1.3}{1.5} \qquad \alpha = 60.07^\circ$$

ko $\alpha' = 90^\circ \quad \sin\alpha' = 1 \qquad \beta = 90 - \alpha \approx 30^\circ$

$n_1 = 1.4 \quad n_2 = 1.8$

(13)



$$\alpha = \frac{180-45°}{2} = 67.5°$$

$$\beta = 90 - \alpha = 22.5°$$

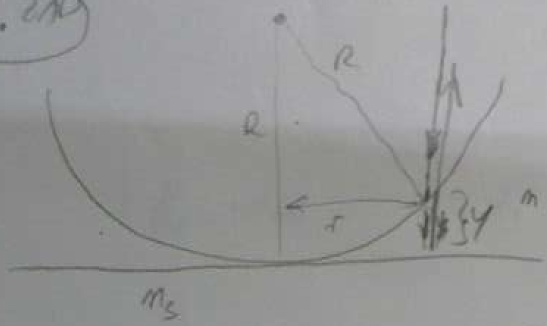
$$\frac{\sin\beta}{\sin\gamma} = \frac{n_1}{n_2} \Rightarrow \sin\gamma = \frac{n_2}{n_1}\cdot\sin\beta \qquad \gamma = 29.4735395°$$

$$\delta = 180-(90-\gamma)-45° = 74.4735395°C$$

$$\frac{\sin(90-\delta)}{\sin(90-\varepsilon)} = \frac{n_2}{n_1} \Rightarrow 90-\varepsilon = 12.01678°$$

$$\underline{\varepsilon = 77.9832°}$$

16. ZAD



$$r^2 + (R-y)^2 = R^2$$

$$r^2 + \cancel{R^2} - 2Ry + y^2 = \cancel{R^2}$$

$$r = \sqrt{2Ry}$$

$n_s > n$

$$\Delta = 2ny + \frac{\lambda}{2}$$

(tamni prsten)

$$y = \frac{\Delta - \frac{\lambda}{2}}{2n} \Rightarrow \Delta = \frac{2m+1}{2}\lambda$$

$$y = \frac{\lambda m}{2n} \Rightarrow r = \sqrt{2R\frac{\lambda m}{2n}}$$

$$\frac{r_1}{r_n} = \frac{\sqrt{\frac{\lambda m R}{1}}}{\sqrt{\frac{\lambda m R}{n}}} = \sqrt{n}$$

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17. ZAD

$$r = \sqrt{2R\,\frac{\Delta - \frac{\lambda}{2}}{2n}} = \sqrt{\frac{R}{n}\left(\Delta - \frac{\lambda}{2}\right)}$$

$$r_5 = r_6 \Rightarrow \frac{R}{1}\left(5\lambda - \frac{\lambda}{2}\right) = \frac{R}{n}\left(6\lambda - \frac{\lambda}{2}\right)$$

$$n = \frac{6\lambda - \frac{\lambda}{2}}{5\lambda - \frac{\lambda}{2}} = \frac{\frac{11}{2}}{\frac{9}{2}} = 1.2$$

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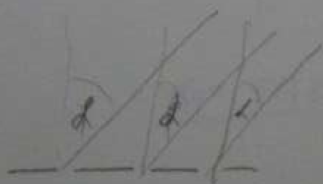
18. ZAD

$\lambda_1 = 750\,nm$

$\lambda_2 = 500\,nm$



$$\sin\alpha = \frac{\lambda}{d} m$$

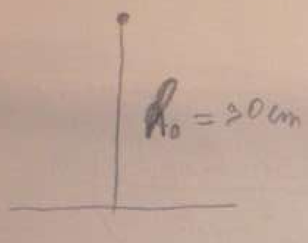
$$\frac{\lambda_1}{\cancel{d}} m = \frac{\lambda_2}{\cancel{d}}(m+1)$$

$$\frac{\lambda_1}{\lambda_2} = 1 + \frac{1}{m} \Rightarrow m = \frac{1}{\frac{\lambda_1}{\lambda_2} - 1} = 2$$

$$d = \frac{\lambda m}{\sin\alpha}$$

19. ZAD

I



$$E_0 = \frac{I}{h_0^2}$$

II

$r_1 = ?$

III

$r_2 = r_1 + \Delta r$ $\qquad$ $\Delta h = h_2 - h_1 = ?$

$$E_0 = \frac{I}{h_0^2} = \frac{I}{h_1^2 + r^2} \cdot \frac{h_1}{\sqrt{h_1^2 + r_1^2}} = \frac{I h_1}{(h_1^2 + r_1^2)^{3/2}}$$

$$\frac{1}{h_0^2 h_1} = \frac{1}{(h_1^2 + r_1^2)^{3/2}} \implies r_1^2 = (h_0^2 h_1)^{2/3} - h_1^2$$

$$\underline{r_1 = 50{,}81 \text{ cm}}$$

$$E_0 = \frac{I(h_1 + \Delta h)}{\left((h_1+\Delta h)^2 + (r_1 + \Delta r)^2\right)^{3/2}} = \frac{I(h_1 + \Delta h)}{\left(h_1^2 + 2\Delta h h_1 + \cancel{\Delta h^2} + r_1^2 + 2r_1\Delta r + \cancel{\Delta r^2}\right)^{3/2}} = \frac{I(h_1+\Delta h)}{\left(h_1^2 + r_1^2 + 2(\Delta h h_1 + \Delta r r_1)\right)^{3/2}}$$

$$= \frac{I(h_1 + \Delta h)}{(h_1^2 + r_1^2)^{3/2}\left(1 + \frac{2(h_1\Delta h + r_1 \Delta r)}{h_1^2 + r_1^2}\right)^{3/2}} = \frac{I(h_1 + \Delta h)}{(h_1^2 + r_1^2)^{3/2}} \cdot \left(1 + \frac{2(h_1 \Delta h + r_1 \Delta r)}{h_1^2 + r_1^2}\right)^{3/2}$$

$$E_0 = \frac{I}{(h_1^2 + r_1^2)^{\frac{3}{2}}} (h_1 + \Delta h) \cdot \left(1 - \frac{3}{\cancel{2}} \frac{\cancel{2}(r_1 \Delta r + h_1 \Delta h)}{h_1^2 + r_1^2}\right)$$

$$= \frac{I h_1}{(h_1^2 + r_1^2)^{\frac{3}{2}}} \left(1 + \frac{\Delta h}{h_1} - \frac{3(r_1 \Delta r + h_1 \Delta h)}{h_1^2 + r_1^2} - \cancel{\frac{\Delta h}{h} \cdot \frac{3(r_1 \Delta r + h_1 \Delta h)}{h_1^2 + r_1^2}}^{\,0}\right)$$

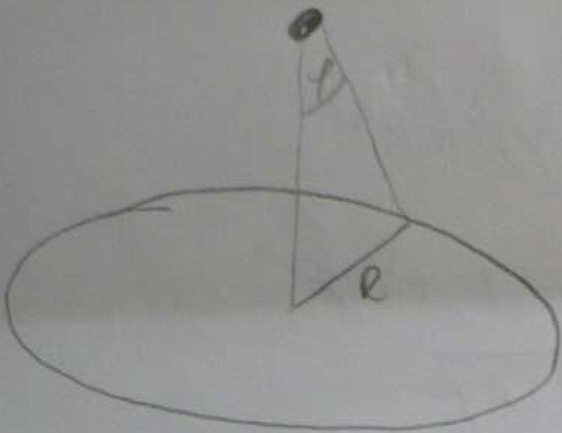
II slučaj $\quad E_0 = \dfrac{I h_1}{(h_1^2 + r_1^2)^{3/2}}$

$$0 = \frac{\Delta h}{h_1} - \frac{3 r_1 \Delta r}{h_1^2 + r_1^2} - \frac{3 h_1 \Delta h}{h_1^2 + r_1^2} \quad / \; h_1(h_1^2 + r_1^2)$$

$$0 = \Delta h (h_1^2 + r_1^2) - 3 r_1 \Delta r h_1 - 3 h_1^2 \Delta h$$

$$\frac{3 r_1 \Delta r h_1}{h_1^2 + r_1^2 - 3 h_1^2} = \Delta h = 9{,}892 \text{ cm}$$

20.



$$E = \frac{I}{r^2} \cos\varphi$$

$$r = \sqrt{h^2 + R^2}$$

$$E(h) = \frac{Ih}{(h^2+R^2)^{3/2}}$$

$$\frac{dE}{dh} = 0 \qquad \frac{(h^2+R^2)^{3/2} - h\,\frac{3}{2}(h^2+R^2)^{1/2} \cdot 2h}{(h^2+R^2)^3} = 0$$

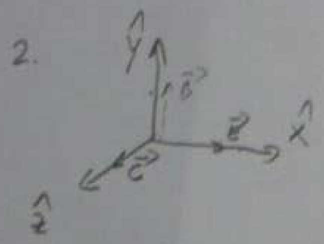
$$h^2 + R^2 - \frac{3}{2}\, 2h^2 = 0$$

$$h = \frac{R}{\sqrt{2}}$$

21. ZAD

2012/13 ZIR

2.



→ pravilo desne ruke → B je u $\hat y$ smjeru

$E_0 = B_0 c \qquad f = 10\,GHz \qquad \omega = 2\pi f$

$$E(\vec r,t) = B_0 c\cos(2\pi f t - \vec k \vec r)\,\hat x \qquad |k| = \frac{2\pi f}{c}$$

$$B(\vec r,t) = B_0 \cos(2\pi f t - \vec k \vec r)\,\hat y$$

$$\vec S(r,t) = \frac{1}{\mu_0}(\vec E \times \vec B) = \frac{1}{\mu_0}\begin{vmatrix} \hat x & \hat y & \hat z \\ E & 0 & 0 \\ 0 & B & 0 \end{vmatrix} = \frac{1}{\mu_0} E\cdot B\,\hat z = \frac{1}{\mu_0} B_0^2 c \cos(2\pi f t - \vec k \vec r)\cdot \cos(2\pi f t - \vec k \vec r)\,\hat z$$

$$= \frac{1}{2} B_0^2 c \cos^2(2\pi f t - \vec k \vec r)\,\hat z$$

---

22. ZAD

$\vec k \vec r$ → val ide u smjeru $\hat j + \hat k$

$$\vec E = E_0 \sin\left((z+y)\cdot 10^{-7}\,m^{-1} - \omega t\right)\hat i$$

$$\vec c = 0\hat i + \frac{c}{\sqrt 2}\hat j + \frac{c}{\sqrt 2}\hat k$$

$$\vec B_0 = \frac{\vec c \times \vec E_0}{c^2} = \frac{1}{c^2}\begin{vmatrix} \hat i & \hat j & \hat k \\ 0 & \frac{c}{\sqrt 2} & \frac{c}{\sqrt 2} \\ E_0 & 0 & 0 \end{vmatrix} = 0\cdot\hat i + \frac{E_0}{\sqrt 2 c}\hat j - \frac{E_0}{\sqrt 2 c}\hat k$$

$$\vec B_0 = \frac{E_0}{c}\sin\left((z+y)\,10^{-7}\,m^{-1} - \omega t\right)\left(\frac{\hat j}{\sqrt 2} - \frac{\hat k}{\sqrt 2}\right)$$

$$\vec S = \frac{1}{\mu_0}(\vec E \times \vec B) = \frac{1}{\mu_0}\frac{E^2}{c}\sin^2(arg)\left(\frac{\hat j}{\sqrt 2} + \frac{\hat k}{\sqrt 2}\right)$$

$$\langle S\rangle = \frac{1}{\mu_0}\frac{E^2}{2c}$$

23. ZADATAK

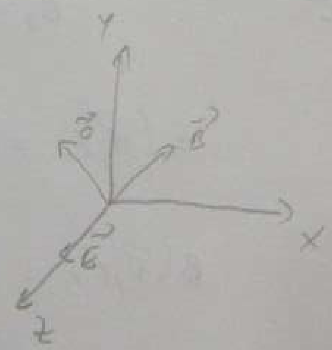
$\bar{S} = 0{,}5\ W/m^2$

$\lambda = 600\ nm$

$\hat{c} = (-\hat{i}+\hat{j})\sqrt{2}$ — B je u x-y ravnini

$\vec{E} = E_0 \sin(\omega t - \vec{k}\vec{r})\,\hat{k}$ — desna ruka

$\vec{B} = \frac{E_0}{c} \sin(\omega t - \vec{k}\vec{r}) \left(\frac{\hat{i}}{\sqrt{2}} + \frac{\hat{j}}{\sqrt{2}}\right)$



$\bar{S} = \frac{1}{2} c \varepsilon E_0^2 = \bar{u}$

$E_0 = \sqrt{\frac{2\bar{S}}{\varepsilon c}}$ $\qquad B = \frac{E_0}{c}$

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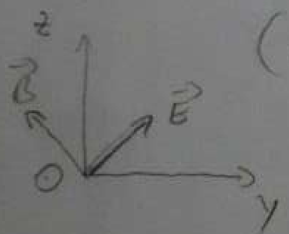
24. ZADATAK

$\hat{c} = \hat{i}$ $\qquad E_0 = 220\ V/m$



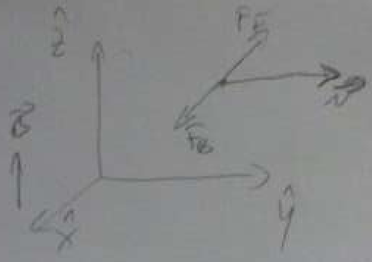
(desna ruka)

$B_0 = \frac{E_0}{c}$

RASPIS PREKO DET.

$\vec{B}_0 = \frac{\vec{c} \times \vec{E}_0}{c^2} = \frac{1}{c^2}\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ c & 0 & 0 \\ 0 & \frac{E_0}{\sqrt{2}} & \frac{E_0}{\sqrt{2}} \end{vmatrix} = 0\,\hat{i} - \begin{vmatrix} c & 0 \\ 0 & \frac{E_0}{\sqrt{2}c^2} \end{vmatrix}\hat{j} + \begin{vmatrix} c & 0 \\ 0 & \frac{E_0}{\sqrt{2}c^2} \end{vmatrix}\hat{k} = -\frac{E_0}{\sqrt{2}c}\hat{j} + \frac{E_0}{\sqrt{2}c}$

25. ZAD
2013/2014



$$\vec{F}_L = q(\vec{E} + \vec{v}\times\vec{B}) = 0$$

$$F_E = -F_B = -qvB\ \hat{x}$$

$$\cancel{q}E = -\cancel{q}vB\ \hat{x}$$

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26 ZAD
2010/2011 P(t)

$$P = \frac{dE}{dt}$$

$$\bar{P} = A \cdot \frac{dx}{dt} \cdot \bar{u}$$

$$\bar{u} = \frac{P}{4\pi R^2 c}$$

$$\bar{u} = \frac{1}{2}\varepsilon E_0^2 \Rightarrow E_0 = \sqrt{\frac{2\bar{u}}{\varepsilon}} = \sqrt{\frac{2\frac{P}{4\pi R^2 c}}{\varepsilon}} = \sqrt{\frac{P}{2\pi\varepsilon R^2 c}}$$

$$B_0 = \frac{E_0}{c} = \sqrt{\frac{P}{2\pi\varepsilon R^2 c^3}}$$

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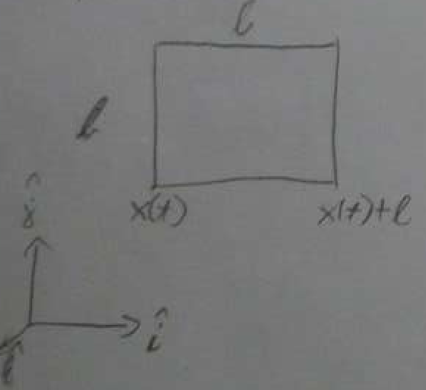
27 ZAD



$$\oint_C \vec{E}\,d\vec{l} = -\frac{\partial}{\partial t}\int \vec{B}\,d\vec{S}$$

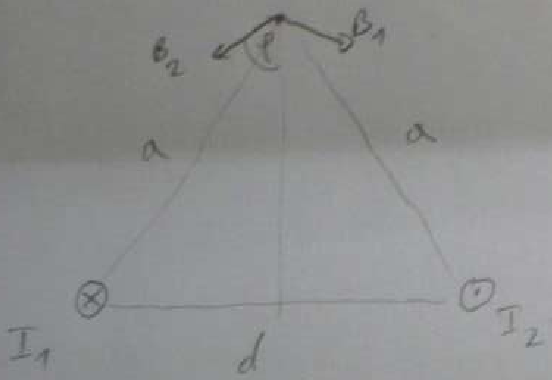
$$\parallel$$

$$U_i = -\frac{\partial}{\partial t}\int_{x(t)}^{x(t)+l} dx \int_0^l B\,dy = -\frac{\partial}{\partial t}\int_{x(t)}^{x(t)+l} B_0 x\, l\, dx =$$

$$= -\frac{\partial}{\partial t}\left(\frac{B_0 l}{2}\left((vt+l)^2 - (vt)^2\right)\right) =$$

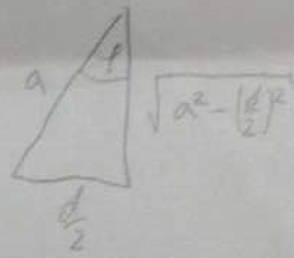
$$= -\frac{B_0 l}{2}\left[-\frac{\partial}{\partial t}\left(2vtl + l^2\right)\right] = \frac{B_0 l}{2}(-vl) = B_0 l$$

28. ZAD



$$\oint_c \vec{B}\, d\vec{l} = NI\mu_0$$

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



$$B_x = B_1 \sin\varphi - B_2 \sin\varphi = \left(\frac{I_1\mu_0}{2a\pi} - \frac{I_2\mu_0}{2a\pi}\right)\frac{\sqrt{a^2-\left(\frac{d}{2}\right)^2}}{a}$$

$$B_y = -B_1\cos\varphi - B_2\cos\varphi = -(I_1+I_2)\frac{\mu_0}{2a\pi}\frac{d}{2a}$$

$$B_x = (I_1 - I_2)\frac{\mu_0}{2a\pi}\sqrt{1-\left(\frac{d}{2a}\right)^2} \qquad B_y = -(I_1+I_2)\frac{\mu_0}{2a\pi}\frac{d}{2a}$$