ZADATAK 1.

$$\vec{E}(\vec{r},t) = \vec{E}_0 \cos\left[\vec{K}\cdot\vec{r} - \omega t + \phi\right]$$

$\vec{K}\cdot\vec{E}_0 = 0 \rightarrow$ okomiti

$\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$

$$\vec{K} = K\vec{i}$$

$\hookrightarrow \frac{2\pi}{\lambda} = K \quad , \quad \omega = K\cdot c$

$$\vec{E}_0 = E_0 \cdot \frac{\vec{j}+\vec{k}}{\sqrt{2}}$$

$\vec{K}\cdot\vec{r} = kx \rightarrow$ zbog smjera $\vec{i}$

$$\vec{E}(x,t) = E_0 \frac{\vec{j}+\vec{k}}{\sqrt{2}} \cos\left[\frac{2\pi}{\lambda}(x-ct)+\phi\right]$$

$$\vec{B} = \underset{\vec{i}}{\hat{k}} \times \underset{\vec{j}+\vec{k}}{\frac{\vec{E}}{c}} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & 0 & 0 \\ 0 & \frac{E}{c} & \frac{E}{c} \end{vmatrix} = \frac{1}{c}\left(-\vec{j}E + \vec{k}E\right) = \frac{E_0}{c}\frac{-\vec{j}+\vec{k}}{\sqrt{2}}\cos[\ ]$$

$|\hat{k}| = 1$

$E(\vec{j}+\vec{k})$

$\hat{k} = |\hat{k}|\vec{i}$

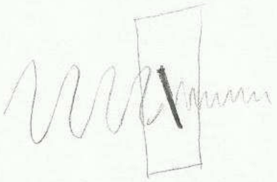
$$\vec{S} = \frac{1}{\mu_0}\vec{E}\times\vec{B} = \frac{1}{\mu_0}\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 0 & E & E \\ 0 & -B & B \end{vmatrix} = \frac{1}{\mu_0}\cdot\frac{E_0^2}{c}\vec{i}\cos^2[\ ]$$

$E(\vec{j}+\vec{k})$

$B(-\vec{j}+\vec{k})$

ZADATAK 2

neki val $\vec{E}$



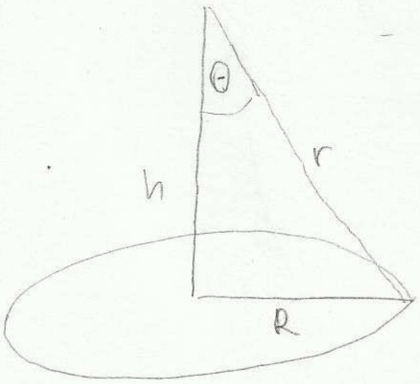
$$\vec{E} \cdot \vec{P}_0 = \vec{E} \cdot \frac{3\hat{i}+\hat{j}}{\sqrt{10}} \rightarrow \text{polarizirani val}$$

smjer polarizatora

$|3\hat{i}+\hat{j}|$

$$\vec{P}_0 = \frac{3\hat{i}+\hat{j}}{|\vec{P}|}$$

ZADATAK 3



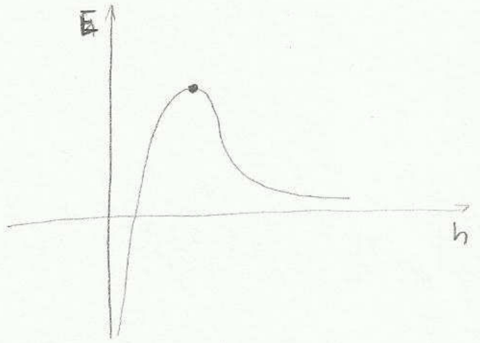
$$E = I \frac{\cos\Theta}{r^2}$$

$$r^2 = h^2 + R^2$$

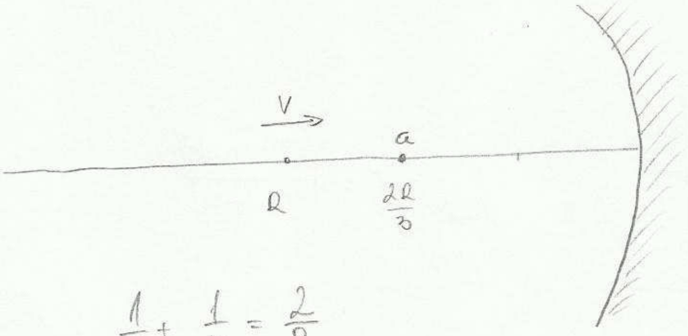
$$\cos\Theta = \frac{h}{r} = \frac{h}{\sqrt{h^2+R^2}}$$

$$E = I \cdot \frac{h}{(h^2+R^2)^{\frac{3}{2}}}$$

$$\frac{\partial E}{\partial h} = 0 = \left(\frac{1}{h} - \frac{3}{2}\frac{1}{R^2+h^2} 2h\right) I \Rightarrow \quad h = \frac{R}{\sqrt{2}}$$



ZADATAK 4



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

$$\hookrightarrow \frac{1}{b}=\frac{2a-R}{aR}$$

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

$$\Rightarrow b=\frac{aR}{2a-R}$$

$\underline{a(t),\ b(t)}$

$$\frac{db(t)}{dt}=\frac{R\cdot(2a-R)-\cancel{aR}}{(2a-R)^2}\cdot\frac{da}{dt}$$

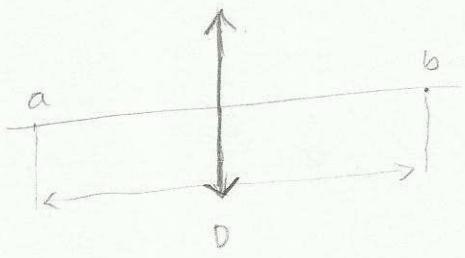
$$\frac{db}{dt}=\frac{db}{da}\cdot\frac{da}{dt}$$

$$\frac{db}{dt}=-\frac{v}{(1-2\frac{a}{R})^2}\Bigg|_{a=\frac{2R}{3}}=-\frac{v}{(1-\frac{2\cdot 2}{3})^2}=-\frac{v}{(-\frac{1}{3})^2}=-9v$$

ZADATAK 5

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

2: $D = a + b$



1: $b = \frac{a \cdot f}{a - f}$

$1 \to 2$: $D = a + \frac{af}{a-f} = \frac{a^2}{a-f}$.

$\frac{\partial}{\partial a} D = 0 = \left(\frac{2}{a} - \frac{1}{a-f} \right) \Rightarrow a = 2f$

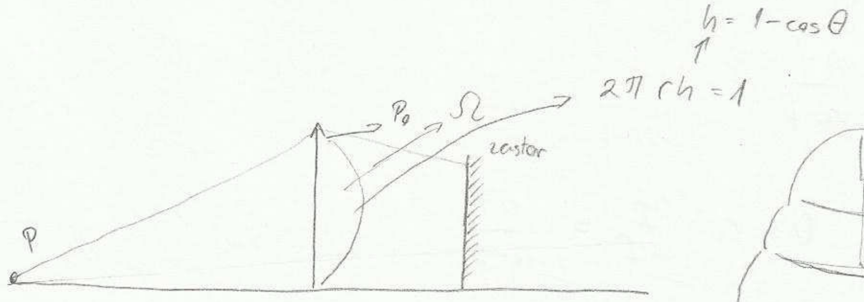
$D_{min} = 4f$

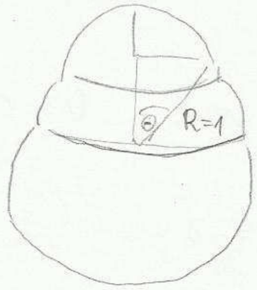
6 ZADATAK

formule za pomoć: $E = \frac{P}{S}$

$$\frac{P_0}{P} = \frac{\Omega}{4\pi}$$

skica:



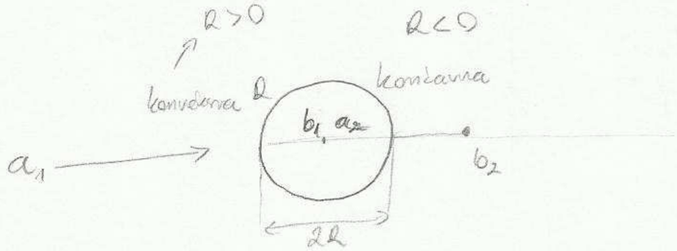


$$\frac{P_0}{P} = \frac{\Omega}{4\pi}$$

ZADATAK 7

$n = 1.5$

$2R = 1\,cm$



$$\frac{1}{a_1} + \frac{n}{b_1} = \frac{n-1}{R} \quad , \quad a_1 \to \infty$$

$$a_2 = 2R - b_1$$

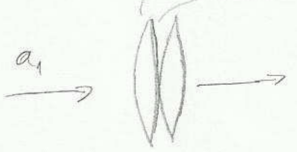
II $$\frac{n}{a_2} + \frac{1}{b_2} = \frac{1-n}{-R}$$

$$b_2 = \frac{R(2-n)}{2(n-1)}$$

$$d = b_2 + R = 0.75\,cm$$

ZADATAK 8

izlaz iz ovog = ulaz za , itd...



ulaz u I. leću: $a_1 \to \infty$

$$\cancel{\frac{1}{a_1}} + \frac{n_L}{b_1} = \frac{n_L - 1}{+R}$$

izlaz iz I. leće:

kad je zrak $n_T = 1$

$$\frac{n_L}{a_2} + \frac{n_T}{b_2} = \frac{n_T - n_L}{-R}$$

ulaz u II. leću:

$$\frac{n_T}{a_3} + \frac{n_L}{b_3} = \frac{n_L - n_T}{+R}$$

izlaz iz II. eleće:

$$\frac{n_L}{a_4} + \frac{1}{b_4} = \frac{1 - n_L}{-R}$$

$a_2 = -b_1$ → zbog zanemarivih udaljenosti

$a_3 = -b_2$

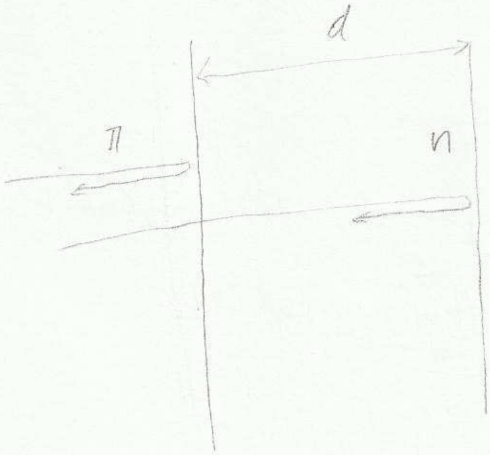
$a_4 = -b_3$

$$\frac{1}{f_T} = \frac{1}{a_1} + \frac{1}{b_4} \Rightarrow f_T = \Big(\underbrace{\cancel{\frac{1}{a_1}}}_{=0} + \frac{1}{b_4}\Big)^{-1} \qquad f_T = b_4 = \frac{R}{4n_L - 2(n_T + 1)}$$

za $n_T = 1 \to f_T = \dfrac{R}{4n_L - 4} \to R = f_T \cdot 4(n_L - 1)$

$\dots \simeq 1.538\,m$

ZADATAK 9.



$$\Delta\phi = 2\pi \frac{\Delta s}{\lambda} + \pi$$

$\Delta s = s_2 - s_1 = 2 \cdot n \cdot d$ → optički put koji svjetlost pređe

$$\Delta\phi = 2\pi \frac{2nd}{\lambda} + \pi$$

$$\Delta\phi_p = 2\pi \frac{2nd}{\lambda_p} + \pi = (2k+1)\pi$$ uvjet destruktivne interferencije

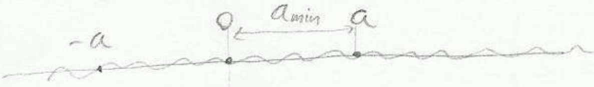
$k', k \in \mathbb{N}$

$$\Delta\phi_c = 2\pi \frac{2nd}{\lambda_c} + \pi = (2k'+1)\pi$$ uvjet konstruktivne interferencije

$$d = \frac{\lambda_c}{4n}(2k'-1) \qquad d = \frac{\lambda_p}{2n} k = \underset{1}{180}, \underset{2}{\underline{360}}, \underset{3}{540} \text{ [nm]}$$

$= \underset{1}{120}, \underset{2}{\underline{360}}, \underset{3}{600}$ [nm]

ZADATAK 10.



$$E(x,t) = E_0 \left[\cos(\omega t - k(x+a)) + \cos(\omega t - kx) + \cos(\omega t - k(x-a))\right]$$

$$= \ldots = \underbrace{E_0 (\overbrace{1 + 2\cos(k\cdot a)}^{=0})}_{\text{amplituda vala}} \cos(\omega t - kx)$$

$$2\cos(k\cdot a) + 1 = 0$$

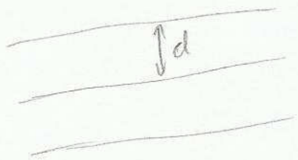
$$\cos(ka) = -\frac{1}{2}$$

$$a_{min} = \underbrace{\frac{1}{k}}_{\frac{\lambda}{2\pi}} \arccos\left(-\frac{1}{2}\right)$$

$$\Rightarrow a_{min} = \frac{\lambda}{3}$$

ZADATAK 11.

$$\sin \alpha = \frac{\lambda}{d} m, \quad m = 0, \pm 1 \pm 2$$



za $m = 3$

$$\sin \alpha_3 = \frac{3\lambda}{d}$$

↳ 3 interfer max

difrakcijski min

$$\sin \alpha' = \frac{\lambda}{a} m \quad m = \pm 1, \pm 2$$

$$\sin \alpha_1' = \frac{\lambda}{a}$$

↳ prvi difrakcijski min

$$\alpha_3 = \alpha_1' =$$

$$\frac{3\lambda}{d} = \frac{\lambda}{a}$$

$$\frac{a}{d} = \frac{1}{3}$$