1. Točkovni izvor EM valovanja izotropno oddaja koherentno EM valovanje pri dveh valovnih dolžinah $\lambda_1 = 2$ m in $\lambda_2 = 1$ m, z enako močjo P = 100 W pri obeh valovnih dolžinah. Kolikšna je povprečna gostota toka EM valovanja na razdalji 5m od izvora ?

$\lambda_1 = 2\,m$

$\lambda_2 = 1\,m$

$P_1 = P_2 = 100\,W$

$\bar{j}(r = 5\,m) = ?$

$$\boxed{w = w_e + w_m = 2 \cdot \frac{1}{2}\varepsilon_0 E^2 = \varepsilon_0 E^2}$$

en izvor: $E = E_0 \cos(\;)$

$\overline{w} = \varepsilon_0 E_0^2 \overline{\cos^2(\;)} = \frac{1}{2}\varepsilon_0 E_0^2$

$$j_1 = \frac{1}{2}\varepsilon_0 E_0^2(r) \cdot c = \frac{P_1}{4\pi r^2} \Rightarrow \boxed{E_0^2(r) = \frac{P_1}{2\pi \varepsilon_0 c r^2}}$$

$$E_1 = E_0(r) e^{i(\omega_1 t - k_1 r)}, \quad E_2 = E_0(r) e^{i(\omega_2 t - k_2 r)}$$

s tem povprečiš

$$\bar{j} = \varepsilon_0 \cdot c \cdot \overline{E^2} = \varepsilon_0 c \overline{(E_1 + E_2)^2} = \varepsilon_0 c \cdot \frac{1}{2}\left[(E_1 + E_2)(E_1 + E_2)^*\right] =$$

$$= \underline{\varepsilon_0 c E_0^2(r)} \left(1 + \cos\left[(\omega_2 - \omega_1)t - (k_2 - k_1) r\right]\right)$$

$$\underline{\bar{j}} = 2 \cdot \left(\frac{1}{2}\varepsilon_0 E_0^2(r)\right) \cdot c = \underline{\varepsilon_0 c E_0^2(r)} = \cancel{\varepsilon_0} \cdot c \cdot \frac{P_1}{2\pi \cancel{\varepsilon_0} c r^2} = \underline{\frac{P_1}{2\pi r^2}} =$$

$$= \underline{0.64\ W/m^2}$$

$$E_0^2 \overline{\cos^2(\omega t)} = \frac{1}{2} E_0^2$$

$$\left.\begin{array}{l} \overbrace{(E_0 e^{i\omega t})}^{E}\overbrace{(E_0 e^{-i\omega t})}^{E} = E_0^2 \\ \frac{1}{2} \text{ manjka za povprečje} \end{array}\right\} \Rightarrow \overline{E^2} = \frac{1}{2} E \cdot E^*$$

6. Dve polaroidni stekli sta postavljeni tako, da prepuščata 25 % ~~intenzitete~~ svetlobe vpadne TOKA popolnoma nepolarizirane svetlobe. Med njiju postavimo 3. polaroidno steklo, tako da je njegova ~~prepustna smer~~ ~~polarizacije svetlobe, ki ju ta prepušča,~~ za kot 25° nagnjena od prepustne smeri ~~polarizacije svetlobe, ki jo prepušča~~ 1. stekla. Koliksen del ~~intenzitete~~ SVETL. TOKA VPADNE popolnoma nepolarizirane svetlobe bo prešel skozi vsa tri ~~stekla~~ polarizatorje. Stekla so idealni polarizatorji, absorpcije ni.

Prepustna smer 3. stekla poteka med prepustnimi smermi 1. in 2. stekla

nepolarizirana svetl. na polarizator

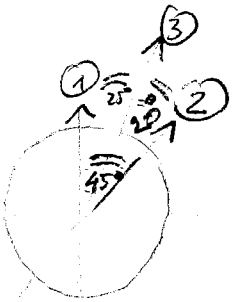
vsi φ-ji $\Rightarrow$ $\cos^2\varphi = \frac{1}{2}$

1 2

1/2

$$\frac{I}{I'} = \frac{1}{2}\cdot\cos^2\varphi_1 = 0.25$$

$$\cos\varphi_1 = \sqrt{\frac{0.25}{0.5}} \Rightarrow \boxed{\varphi_1 = 45^\circ}$$



$$\frac{I}{I''} = \overbrace{\frac{1}{2}\cdot\cos^2(25^\circ)}^{0.41}\cdot\cos^2(20^\circ) = \underline{0.2207}$$

$$\boxed{\frac{I}{I''} = 0{,}36}$$

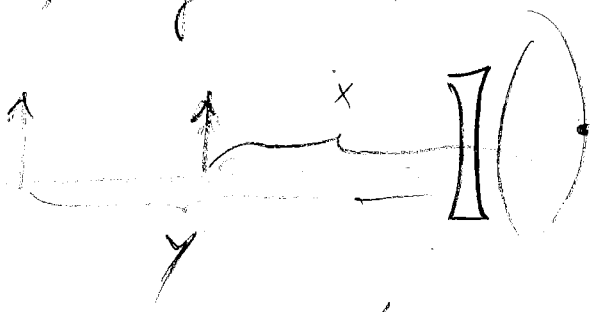
šolsko leto 95/96 OP 16

6. Kratkovidno oko ne vidi jasno predmetov, ki so oddaljeni več kot 1 meter. Kolikšna je dioptrija očal, ki jih oko potrebuje, da vidi jasno predmete do oddaljenosti 5 metrov ?

Oko potrebuje konkavna očala, ki predmet na oddaljenosti 5 m preslika na razdaljo 1 m, kjer oko razloči predmet:

$$\frac{1}{y} + \frac{1}{(-x)} = \frac{1}{f} = D \text{ (dioptrija)}$$

$y = 5$ m
$x = 1$ m



$$\underline{\underline{D}} = \frac{1}{f} = \frac{1}{y} + \frac{1}{(-x)} = \frac{x-y}{x \cdot y} = \frac{-4}{5} = \underline{\underline{-0.8\ m^{-1}}}$$

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

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

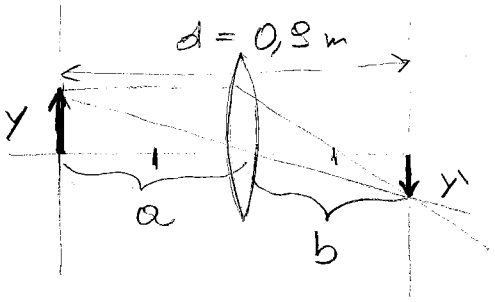
$$\frac{1}{f'} = \frac{1}{a'} - \frac{1}{a} =$$

M-Ž

1992

3. Predmet preslikamo z zbiralno lečo na 90 cm oddaljeni zaslon. Preslikava se posreči pri dveh legah leče. Slika pri prvi legi je štirikrat večja od slike pri drugi. Kolikšen je lomni količnik stekla iz katerega je izdelana leča, če sta oba njena krivinska radija enaka 0,2 m ?

$R = 0{,}2\ m, \quad d = 0{,}9\ m$



$$\boxed{a_1 + b_1 = d} \quad (1)$$

$$\boxed{a_2 + b_2 = d} \quad (2)$$

$$\frac{y_1'}{y_1} = \frac{b_1}{a_1} = 4\frac{y_2'}{y_2} = 4 \cdot \frac{b_2}{a_2} \Rightarrow \boxed{\frac{b_1 \cdot a_2}{a_1 \cdot b_2} = 4}$$

$$\frac{1}{a_1} + \frac{1}{b_1} = \frac{1}{a_2} + \frac{1}{b_2} \Rightarrow \frac{b_1 + a_1}{a_1 b_1} = \frac{b_2 + a_2}{a_2 b_2} \Rightarrow$$

$$\Rightarrow \frac{d}{a_1 b_1} = \frac{d}{a_2 b_2} \Rightarrow \boxed{\frac{a_2 \cdot b_2}{a_1 \cdot b_1} = 1}$$

$$\frac{b_1 a_2 a_1 b_1}{a_1 b_2 a_2 b_2} = 4 \Rightarrow \frac{b_1^2}{b_2^2} = 4 \Rightarrow \boxed{b_1 = 2 b_2}$$

$$\Rightarrow \boxed{a_1 = \frac{1}{2} a_2}$$

$$\left.\begin{aligned} (1) &\Rightarrow a_2 + b_2 = d \\ (2) &\Rightarrow \frac{1}{2} a_2 + 2b_2 = d \end{aligned}\right\} \quad \begin{aligned} a_2 + b_2 &= d \\ a_2 + 4b_2 &= 2d \\ 3b_2 &= d \end{aligned} \Rightarrow \boxed{b_2 = \frac{d}{3}} \Rightarrow \boxed{a_2 = \frac{2}{3} d}$$

$$\frac{1}{f} = \frac{1}{a_2} + \frac{1}{b_2} = \frac{3}{2d} + \frac{6}{2d} = \frac{9}{2d} = (n-1)\frac{2}{R} \Rightarrow$$

$$\boxed{n = 1 + \frac{9R}{4d} = 1{,}5}$$

4. Okroglo ploščico s premerom 5 mm postavimo na oddaljenost 50 cm pred zbiralno lečo tako, da sta ravnini ploščice in leče vzporedni. Zaslon za lečo postavimo tako, da je slika predmeta na zaslonu ostra. Velikost slike je 1 mm. Če nato premaknemo zaslon 1 cm nazaj, postane slika razmazana in visoka 2 mm. Kolikšen je polmer leče ?

$y = 5\ mm$

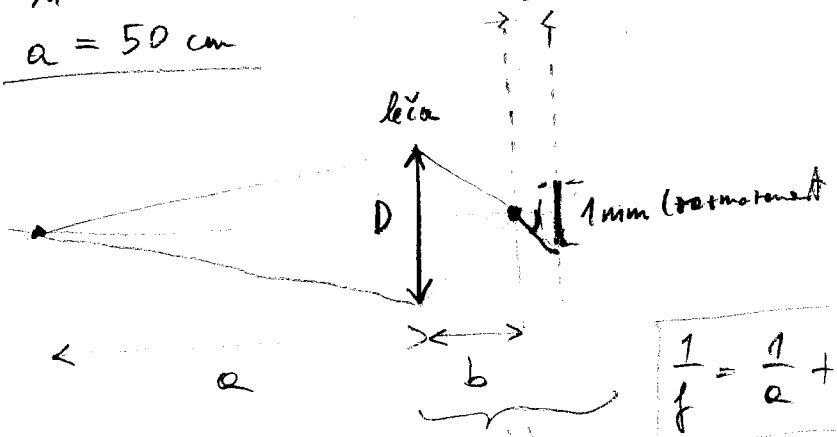
$y_1' = 1\ mm$, $y_2' = 2\ mm$

$a = 50\ cm$

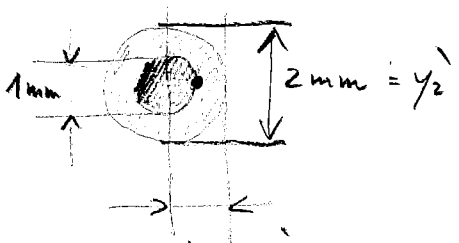
$$\frac{b}{y_1'} = \frac{a}{y}$$

$$\Downarrow$$

$$b = a\,\frac{y_1'}{y} = 10\ cm$$



$$\frac{1}{f} = \frac{1}{a} + \frac{1}{b} \Rightarrow f = 8.33\ cm$$



1 mm je razmaknenost točke

$$\frac{2 \cdot b}{D} = \frac{\Delta}{0.05\ cm}$$

$$\Downarrow$$

$$D = \frac{2 \cdot b \cdot 0.05\ cm}{\Delta} = 1\ cm$$

izpit 1991

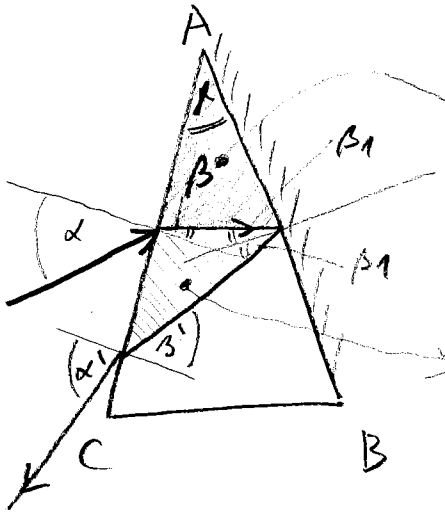
3. Steklena tristranična prizma $\overset{A}{C\ \ B}$ z lomečim kotom med stranico AC in AB 30° (γ) ima stranico AB posrebreno, žarek, ki prihaja iz zraka pada na stranico prizme AC pod kotom 40°. Lomljeni žarek se nato odbije od posrebrene površine AB, vrača na stranico AC, se lomi in zapusti prizmo. Določite kot pod katerim žarek zapusti prizmo! Lomni količnik stekla prizme je 1,57. FN

$\gamma = 30^\circ$

$\alpha = 40^\circ$

$n = 1.57$

$\alpha' = ?$



$\gamma + (90-\beta) + (90-\beta_1) = 180$

$\Downarrow$

$\boxed{\gamma = \beta + \beta_1}$

$2\beta_1 + \beta + 90 + (90-\beta') = 180$

$\Downarrow$

$\boxed{2\beta_1 + \beta = \beta'}$

$\boxed{\frac{\sin\alpha}{\sin\beta} = n} \Rightarrow \beta = 24,17$

$\boxed{\beta_1 = \gamma - \beta} \Rightarrow \beta_1 = 5,83$

$\boxed{\beta' = 2\beta_1 + \beta} \Rightarrow \beta' = 35.83$

$\boxed{\frac{\sin\alpha'}{\sin\beta'} = n} \Rightarrow \boxed{\alpha' \cong 66,8^\circ}$

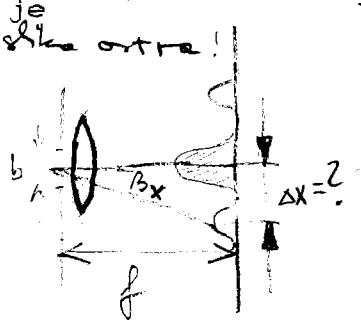
7. Curek svetlobe z valovno dolžino 500 nm gre skozi režo debeline 0,4 mm in lečo z gorišču razdaljo 2 m, ki leži tik za režo. Oceni razdaljo med centr. in 1. ukrivljenim maksimumom, ki ga postavimo na tako razdaljo od reže, da je

slika ostra!

$\lambda = 500$ nm

$f = 2$ m

$b = 0{,}4 \cdot 10^{-3}$ m



$$\boxed{j = j_0 \cdot \frac{\sin^2(\pi b \sin\beta/\lambda)}{(\pi b \sin\beta/\lambda)^2}}$$

$\beta = 0 \rightarrow$ centr. maksimum

1. minimum $\rightarrow \pi b \sin\beta_1/\lambda = \pi \Rightarrow b \sin\beta_1 = \lambda$

2. minimum $\rightarrow \pi b \sin\beta_2/\lambda = 2\pi \Rightarrow b \sin\beta_2 = 2\lambda$

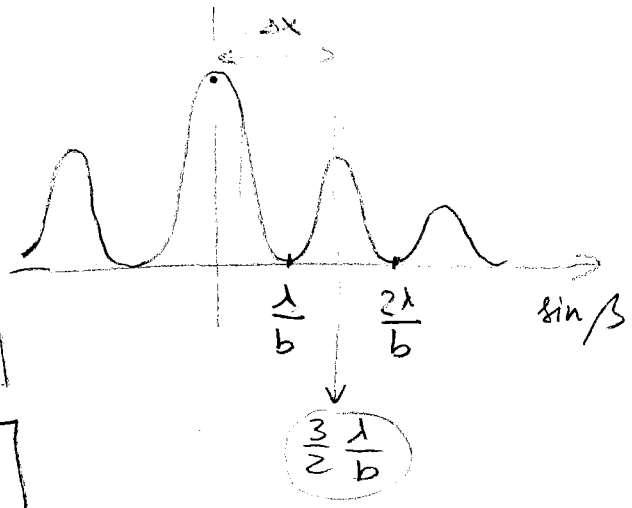
$$\boxed{b \cdot \sin\beta_N = N\lambda, \quad N = 1, 2, \ldots \quad \text{maksimumi ovojnice}}$$

1. maksimum:

$$\boxed{\sin\beta_x = \frac{3}{2}\frac{\lambda}{b} \approx \beta_x}$$

$$\boxed{\operatorname{tg}\beta_x = \frac{\Delta x}{f} \Rightarrow \Delta x = f \cdot \operatorname{tg}\beta_x \approx f \cdot \beta_x}$$

$$\boxed{\Delta x = f \cdot \frac{3}{2}\frac{\lambda}{b} = \underline{\underline{3{,}75 \text{ mm}}}}$$

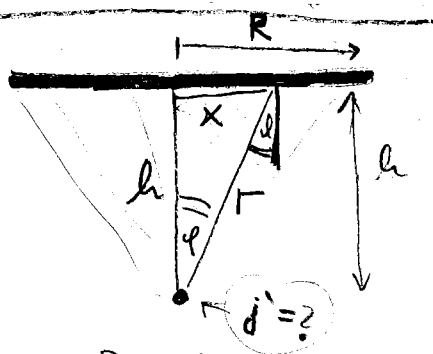


$$\frac{\sin^2\alpha}{\alpha^2} \rightarrow \frac{2\sin\alpha\cos\alpha}{2\alpha} \rightarrow \frac{2(\cos^2\alpha - \sin^2\alpha)}{2} \rightarrow \frac{\cos 2\alpha}{2}$$

$\alpha = \pi, 2\pi \ldots$ $\qquad$ $\alpha = 0$

$\lim \rightarrow 0$ $\qquad$ $\lim \rightarrow \frac{1}{2}$

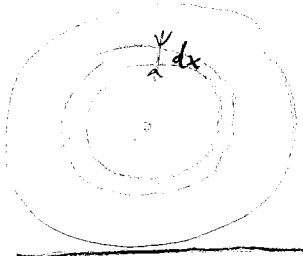
4. Nad ~~veliko okrogło~~ mizo je na strop pritrjena svetilka v obliki tanke krozne plosče s polmerom 40 cm. Svetlost svetilke je neodvisna od smeri in enaka 100 W/m^2·sterad. ~~Središče svetilke je torej pod stropom na mizi.~~ Kolikšna je osvetljenost ~~središča~~ POD SREDIŠČEM SVETILKE mize, če je višinska razlika med stropom in površino mize 2 m?



$R = 0{,}4\,m$

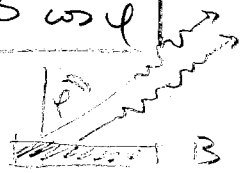
$h = 2\,m$

$B = 100\ W/m^2$



$$\boxed{j' = j\cos\varphi}$$

$$\boxed{I = B\,S\cos\varphi}$$



$$\boxed{j = \frac{P}{4\pi r^2} = \frac{P/4\pi}{r^2} = \frac{I}{r^2}}$$

$$\boxed{r^2 = x^2 + h^2}$$

$$dj' = \left(\frac{B\,dS\cos\varphi}{r^2}\right)\cos\varphi = \frac{B\cdot 2\pi x\cdot dx}{r^2}\cdot\cos^2\varphi \quad , \quad \boxed{\cos\varphi = \frac{h}{r}}$$

$$= 2\pi B h^2\,\frac{x\,dx}{r^4} = 2\pi B\,\frac{x\,dx}{(x^2+h^2)^2}$$

$$u^n = \frac{u^{n+1}}{n+1} = -\frac{1}{n}$$

$$j' = 2\pi B h^2\int_0^R \frac{x\,dx}{(x^2+h^2)^2} = h^2\pi B\int_{h^2}^{R^2+h^2}\frac{du}{u^2} = \pi B h^2\left[\frac{1}{h^2} - \frac{1}{R^2+h^2}\right]$$

$$\boxed{x^2 + h^2 = u} \quad 2x\,dx = du \Rightarrow x\,dx = \frac{du}{2}$$

$$\boxed{j' = \pi B h^2\left[\frac{1}{h^2} - \frac{1}{(R^2+h^2)}\right] = 12{,}08\ W/m^2}$$

$$= \pi\cdot 100\cdot 4\left[0.25 - \frac{1}{4.16}\right] = 12{,}08\ \frac{W}{m^2} \qquad = \frac{\pi B R^2}{R^2+h^2}$$

Ali brez izpeljave:

$$j = \frac{BS}{h^2} = \frac{\pi\,16\cdot 10^{-2}\cdot 100}{4} = \frac{50{,}2}{4} = 12.55\ \frac{W}{m^2} \qquad j = \frac{B\pi R^2}{h^2}$$

5. Na eno stran ravne homogene kvadratne plošče s stranico dolžine 1 m, ki se nahaja v vesolju, pada v pravokotni smeri linearno polarizirano EM valovanje z amplitudo električne poljske jakosti 100 V/m. Albedo plošče je enak 0,6. Oceni kolikšen energijski tok oddaja plošča v stacionarnem stanju ?

1884

$d = 1\ m$

$E_0 = 100\ V/m$

$a = 0{,}6$

(ni odvisen od valovne dolžine in)

$$w = w_e + w_m = 2w_m = 2w_e = 2\cdot\tfrac{1}{2}\varepsilon_0 E^2 = \varepsilon_0 E^2$$

$$\text{ce } E = E_0\cdot\cos(\omega t - kx) \Rightarrow$$

$$\overline{w} = 2\cdot\tfrac{1}{2}\varepsilon_0 E_0^2\,\underbrace{\overline{\cos^2(\omega t - kx)}}_{\frac{1}{2}\text{ povprečje}} = \tfrac{1}{2}\varepsilon_0 E_0^2$$

$$\boxed{j_0 = \overline{w}\cdot c} \longrightarrow \boxed{j_0 = \tfrac{1}{2}\varepsilon_0 E_0^2\cdot c_0}$$

$\boxed{S = d^2}$

absorbirani svetlobni tok:

$$\boxed{j_{abs} = j_0 - j_{odb} = j_0 - a\cdot j_0 = (1-a)\,j_0}$$

RAVNOVESJE:

$$P_{izs} = P_{abs} = S\cdot(1-a)\cdot j_0 \Rightarrow$$

$$\boxed{P_{izs} = d^2\cdot(1-a)\cdot\tfrac{1}{2}\varepsilon_0 E_0^2\cdot c_0 = \underline{\underline{5{,}31\ W}}}$$

Fizika 4 (p. izpit dec. 1992)

3. Povprečna temperatura na površini Zemlje je 15° C. Za koliko bi se spremenila, če bi se zaradi efekta tople grede emisivnost Zemlje zmanjšala za 5 procentov, količina absorbirane ~~sv~~ sončne svetlobe pa se ne bi spremenila ?

$T_0 = 15°C = \underline{288\ K}$

$e_1 = 0.95\, e_0$

$j = (1-a)\sigma T^4 = e \cdot \sigma T^4$

$e_0 \sigma T_0^4 S = P_{abs}$, $e_1 \cdot \sigma \cdot T_1^4 \cdot S = P_{abs}$

$e_0 \sigma T_0^4 = e_1 \sigma T_1^4$

$T_0^4 = 0.95 \cdot T_1^4 \Rightarrow T_1 = \sqrt[4]{\frac{T_0^4}{0.95}} = \underline{291.7\ K}$

$\boxed{\Delta T = 3.7\ K}$

$\frac{\Delta T}{T} \cong 0{,}013$

4. Na eno stranico satelita v obliki kocke s stranico 5 cm, ki se nahaja v vesolju, pada v pravokotni smeri EM valovanje z amplitudo **električne** poljske jakosti 100 V/m. Albedo satelita je enak 0,6. Oceni **koliksen** energijski tok oddaja satelit v stacionarnem stanju in kolikšna je stacionarna temperatura satelita.

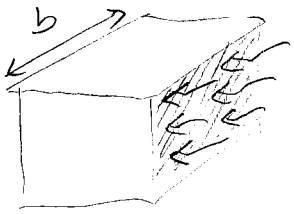
$\varepsilon_0 = 8{,}85 \cdot 10^{-12}\ As/Vm$

$\sigma = 5{,}67 \cdot 10^{-8}\ W m^{-2} K^{-4}$

$b = 0.05\,m$

$E_0 = 100\ \frac{V}{m}$

$a = 0.6$



$$P_{izs} = P_{abs} = b^2 (1-a)\, j_0 =$$

$$= b^2 (1-a) \tfrac{1}{2} \varepsilon_0 E_0^2 c_0 = 1{,}33 \cdot 10^{-2}\ W$$

$$\left(P_{izs,\,str} = \frac{1}{6} P_{izs} = 2{,}2 \cdot 10^{-3}\ W \right)$$

$$P_{abs} = 6 \cdot b^2 \cdot (1-a)\, \sigma T^4$$

$$T_s = \left[\frac{P_{abs}}{6 \cdot b^2 (1-a) \sigma} \right]^{1/4} = \left[\frac{\cancel{b^2} (1-a) \frac{1}{2} \varepsilon_0 E_0^2 c_0}{6\, \cancel{b^2} (1-a) \sigma} \right]^{1/4} =$$

$$= \left[\frac{\frac{1}{2} \varepsilon_0 E_0^2 c_0}{6 \cdot \sigma} \right]^{1/4} = 79\ K$$

$$\left(\frac{0{,}5 \cdot 8{,}85 \cdot 10^{-12} \cdot 10^{4} \cdot 3 \cdot 10^{8}}{6 \cdot 5{,}67} \cdot 10^{8} \right)^{1/4}$$

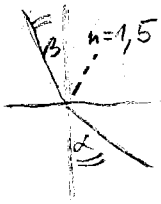
5. Steklena palica z premerom 2 cm se končuje v obliki stožca z višino 1,73 cm. Po geometrijski osi palice potuje zelo tanek curek svetlobe, ki izstopi iz palice v vrhu stožca. 8 cm nad vrhom stožca postavimo zaslon, ki je pravokoten na palico. Kakšen je radij svetlobnega kolobarja, ki se zariše na tem zaslonu ? Lomni količnik stekla je 1,5.

$2r = 2\ cm$

$h = 1{,}73\ cm$

$l = 8\ cm$

$n = 1{,}5$

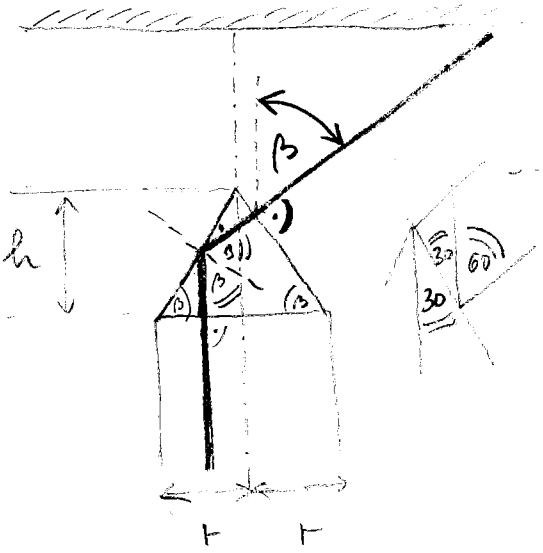


$$\frac{\sin\beta}{\sin\alpha} = \frac{1}{n}$$

mejni kot tot. odboja: $\alpha = 90°$

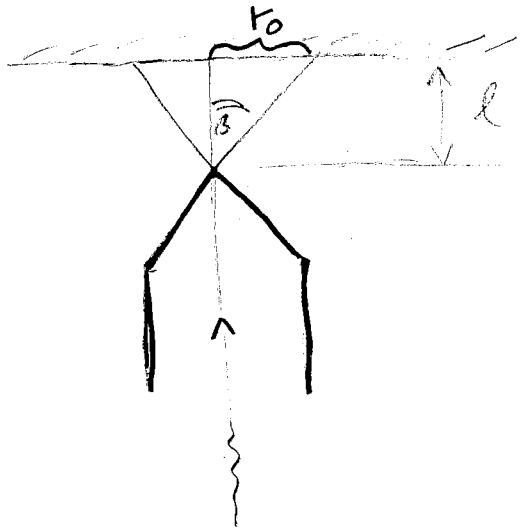
$$\sin\beta_m \cdot n = 1$$

$$\beta_m = \arcsin\frac{1}{n} = 41{,}8°$$



$$\operatorname{tg}\beta = \frac{1{,}73}{1} \Rightarrow \boxed{\beta = 60°}$$

$\beta > 41{,}8 \Rightarrow$ totalni odboj

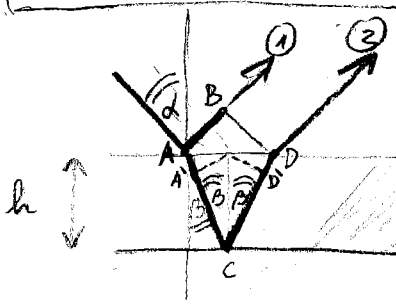


$$\boxed{\operatorname{tg}\beta = \frac{r_0}{l}}$$

$$\Downarrow$$

$$\boxed{r_0 = l \cdot \operatorname{tg}\beta = 13{,}86\ cm}$$

3. Na 0,1 μm debelo plast olja na vodi posvetimo z vzporednim curkom bele svetlobe pod kotom 30°. Lomni kvocient vode je 1,33, lomni kvocient olja pa 1,5. Kakšne barve (λ) se zdi odbita svetloba pri opazovanju s prostim očesom ?



KOHERENTNI CURKI

$n' = 1$ (vakuum)

$\alpha = 30°$ $h = 0{,}1\,\mu m$

$n = 1{,}5$

$n'' = 1{,}33$

$\boxed{n' < n > n''}$

vijolična — rdeča

4000 Å — 6000 Å

$$\boxed{\delta_r = \overline{ACD} - \overline{AB} = 2h\cos\beta}$$

$$= \overline{AA'} + \overline{D'D} + \overline{A'CD'} - \overline{AB} \approx \overline{A'CD'}$$

kar $\overline{AB} \approx \overline{AA'} + \overline{D'D}$

a) E se odbije z nasprotno fazo na opt. gostejši snovi

b) E se odbije z enako fazo na opt. redkejši snovi

žarek 1 se odbije na opt. gostejši snovi ⇒ $\boxed{\delta = \pi}$ oz. $\lambda/2$

žarek 2 se odbije na opt. redkejši snovi ⇒ $\delta = 0$

} dodatni $\delta = \pi$ oz. $\frac{\lambda}{2}$

pogoj za ojačanje: $\boxed{\delta_r + \frac{1}{2}\lambda = N\lambda}$

$$2h\cos\beta + \frac{1}{2}\lambda = N\lambda \quad , N = 1, 2, 3 \ldots$$

$$2h\cos\beta = (2N-1)\frac{\lambda}{2} \quad N = 1, 2, 3$$

$$\boxed{2h\cos\beta = (2N+1)\frac{\lambda}{2}} \quad , N = 0, 1, 2, 3 \quad \text{(začnemo z 0)}$$

⇓

$$\boxed{2hn\cos\beta = (2N+1)\lambda_0/2}$$

če λ_0 v vakuumu ⇒ λ v snovi

$$\boxed{\lambda = \lambda_0/n}$$

⇓

$$\lambda_0 = 4hn\cos\beta/(2N+1) \Rightarrow$$

$$\boxed{\lambda_0 = 4h\sqrt{n^2 - \sin^2\alpha}/(2N+1)}$$

za $N = 0$: $\boxed{\lambda_0 = 565\ nm}$

$$\frac{\sin\alpha}{\sin\beta} = n$$

⇓

$$\frac{\sin^2\alpha}{\sin^2\beta} = n^2$$

⇓

$$\frac{\sin^2\alpha}{1-\cos^2\beta} = n^2$$

$$\sin^2\alpha/n^2 = (1-\cos^2\beta)$$

$$n^2\cos^2\beta = n^2 - \sin^2\alpha$$

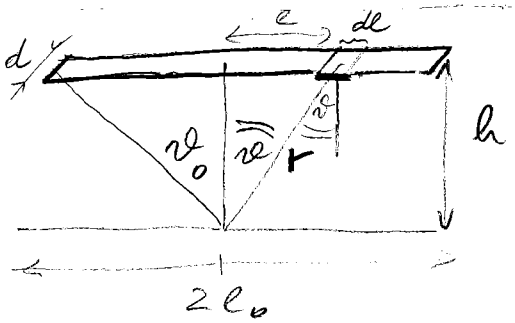
$$\boxed{n\cos\beta = \sqrt{n^2 - \sin^2\alpha}}$$

722-977

2. 2 m visoko nad mizo je 1 m dolga svetilka v obliki tankega traku širine 3 cm. Njena svetlost je 100 W/m^2. Kolikšna je osvetljenost mize pod središčem svetilke ? Odboj svetlobe od stropa in sten zanemarimo.

$h = 2\,m$
$d = 0.03\,m$
$B = 100\,W/m^2$
$l_0 = 0.5\,m$

$j' = ?$



$$tg\,\vartheta_0 = \frac{l_0}{h} = 0.25 \Rightarrow \vartheta_0 = 14.036^\circ$$

$$\boxed{r = \frac{h}{\cos\vartheta}} \Leftarrow \left\{ \cos\vartheta = \frac{h}{r} \right., \quad tg\,\vartheta = \frac{l}{h} \Rightarrow \boxed{dl = \frac{h}{\cos^2\vartheta}\cdot d\vartheta}$$

$$dj' = \frac{dI}{r^2}\cos\vartheta = \frac{B\,dS\cos^2\vartheta}{r^2} = \frac{B\cdot d\cdot dl\,\cos^2\vartheta}{r^2} \Rightarrow$$

$$\boxed{dj' = \frac{B\,d}{h}\cos^2\vartheta\,d\vartheta}$$

$$\cos 2\vartheta = \cos^2\vartheta - \sin^2\vartheta$$
$$= \cos^2\vartheta - (1-\cos^2\vartheta)$$
$$= 2\cos^2\vartheta - 1$$
$$\Downarrow$$
$$\cos^2\vartheta = \frac{1+\cos 2\vartheta}{2}$$

$$j' = 2\left(\frac{B\,d}{h}\right)\int_0^{\vartheta_0}\cos^2\vartheta\,d\vartheta = \frac{B\cdot d}{h}\int_0^{\vartheta_0}(1+\cos 2\vartheta)\,d\vartheta =$$

$$= \frac{B\,d}{h}\left[\vartheta_0 + \frac{1}{2}\sin(2\vartheta_0)\right] = \underline{0.72\ W/m^2}$$

izotropno: $j = \frac{P}{S} = \frac{P}{4\pi r^2} = \frac{I}{r^2}$ ← svetilnost

3. Plankonveksno lečo postavimo s konveksno stranjo navzdol na ravno stekleno ploščo. Pravokotno na površino leče posvetimo z enobarvno svetlobo valovne dolžine 670 nm. Na ravni ploskvi leče opazujemo interferenčne kolobarje odbite svetlobe. Kolikšen je krivinski polmer leče, če je polmer dvajsetega temnega interferenčnega kolobarja 1,1 cm ?

7893

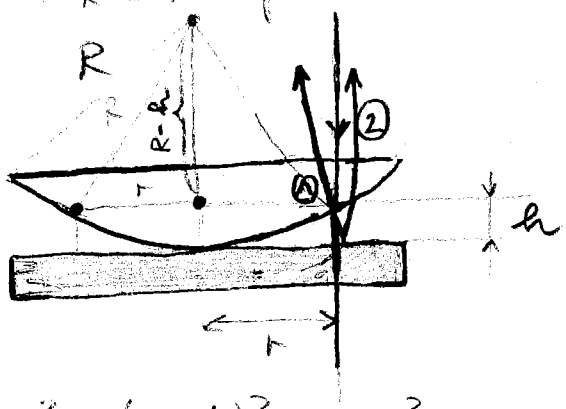
$\lambda_0 = 670$ nm

$r = 1{,}1$ cm

$\boxed{N = 20}$

$r \equiv$ radij kolobarja

$R \equiv$ krivin. polmer leče



osebitev: $\left(\frac{\lambda_0}{2}, \frac{3}{2}\lambda_0, \frac{5}{2}\lambda_0 \ldots\right)$

$\delta_{total} = (2N+1)\frac{\lambda_0}{2}, \quad N = 0, 1, 2, \ldots$

$\delta = \delta_{total} - \delta_r = (2N+1)\frac{\lambda_0}{2} - \frac{\lambda_0}{2} =$

$= N\lambda_0 + \frac{\lambda_0}{2} - \frac{\lambda_0}{2} = N\lambda_0$

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

$r^2 + R^2 - 2Rh + h^2 = R^2 \quad | \; h^2 \ll 1$

$r^2 - 2Rh = 0 \Rightarrow \boxed{h = \frac{1}{2} r^2 / R}$

ob odbitu temna črta $\left(\delta_r = \frac{\lambda}{2}\right)$

osebitev:

$\boxed{\delta_r = \frac{\lambda_0}{2}}$ $\boxed{\delta_{total} = \delta_r + \delta}$ $\Rightarrow$ $\boxed{\delta = 2h = N\lambda_0}$ $N = 0, 1, \ldots 20, \ldots$

$\Downarrow$

$\boxed{h = N\frac{\lambda_0}{2}}$

$R = \frac{r^2}{N\lambda_0}$

$N = 20: \; h = \frac{1}{2} r^2 / R = N\frac{\lambda_0}{2} = 10\lambda_0$

$R = \frac{r^2}{2 \cdot 10 \cdot \lambda_0} = \frac{(1{,}1)^2 \cdot 10^{-4}}{2 \cdot 670 \cdot 10^{-8}} = 90{,}3$ cm ✓

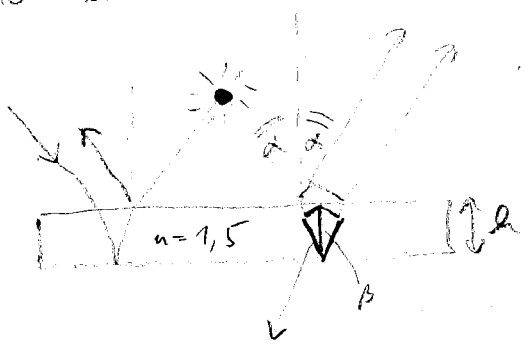
4. S točkastim svetilom, ki seva svetlobo z valovno dolžino 600 nm enakomerno na vse strani, posvetimo na 0,1 μm debelo prozorno ploščico z lomnim količnikom 1,58. Kolikšen je kot ob vrhu osnega preseka stožca, na plašču katerega leži centralni ojačani curek ?

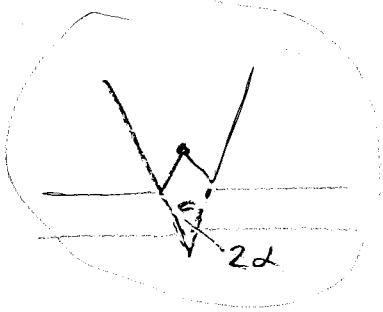
$\lambda_0 = 600\ nm = 6 \cdot 10^{-7}\ m$

$h =$

$n = 1{,}58$

$2\alpha = ?$





$$\boxed{\delta_s + \delta_f = N\lambda}$$

$$\boxed{\delta_s = 2h\cos\beta}$$

$$\boxed{\delta_f = \frac{\lambda}{2}}$$

$$\boxed{\lambda = \frac{\lambda_0}{n}}$$

$$2h\cos\beta + \frac{\lambda_0}{2n} = N\left(\frac{\lambda_0}{n}\right)$$

$$2nh\cos\beta + \frac{\lambda_0}{2} = N\lambda_0$$

$$2nh\cos\beta = (2N-1)\frac{\lambda_0}{2}, \quad N = 1,2,3$$

$$\boxed{2nh\cos\beta = (2N+1)\frac{\lambda_0}{2}, \quad N = 0,1,2,3}$$

$$\Downarrow$$

$$2nh\frac{\sqrt{n^2 - \sin^2\alpha}}{n} = (2N+1)\frac{\lambda_0}{2}$$

$$\boxed{16h^2(n^2 - \sin^2\alpha) = (2N+1)^2\lambda_0^2}$$

$$\frac{\sin\alpha}{\sin\beta} = n$$

$$\Downarrow$$

$$\frac{\sin^2\alpha}{\sin^2\beta} = n^2$$

$$\Downarrow$$

$$\frac{\sin^2\alpha}{1-\cos^2\beta} = n^2$$

$$\Downarrow$$

$$\frac{\sin^2\alpha}{n^2} = (1-\cos^2\beta)$$

$$\Downarrow$$

$$n^2\cos^2\beta = n^2 - \sin^2\alpha$$

$$\Downarrow$$

$$\boxed{\cos\beta = \frac{\sqrt{n^2 - \sin^2\alpha}}{n}}$$

$\underline{N=0}$: $16h^2(n^2 - \sin^2\alpha) = \lambda_0^2$

$$16h^2n^2 - 16h^2\sin^2\alpha = \lambda_0^2$$

$$16h^2n^2 - \lambda_0^2 = 16h^2\sin^2\alpha$$

$$\boxed{\sin\alpha = \sqrt{n^2 - \frac{\lambda_0^2}{16h^2}}} \Rightarrow \alpha = \underline{29{,}76}$$

$$= \sqrt{n^2 - \frac{36\cdot 10^{-14}}{16\cdot 10^{-2}\cdot 10^{-12}}} =$$

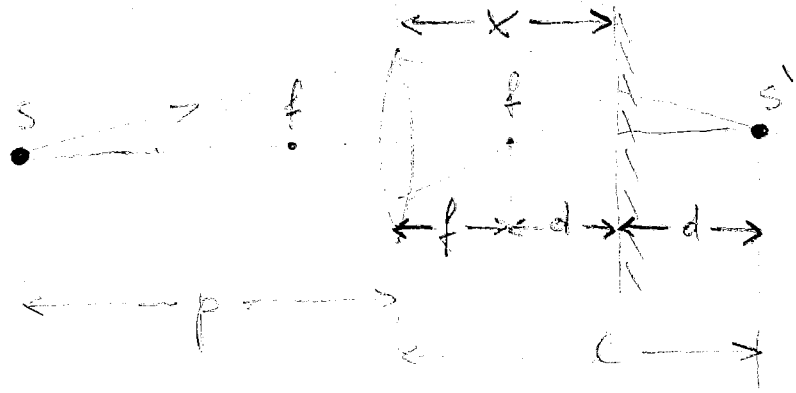
$$\boxed{2\alpha = 59{,}5^\circ}$$

7. Točkasti izvor svetlobe se nahaja na optični osi tanke zbiralne leče na oddaljenosti 9 cm od leče (f = 3 cm). Na kateri oddaljenosti od leče (na nasprotni strani od svetlobnega izvora) moramo postaviti ravno ogledalo, da bi bili od ogledala odbiti žarki po ponovnem prehodu skozi lečo vzporedni z optično osjo leče ?

24.8.

$f = 3\,cm$

$p = 3f = 9\,cm$



$\rightarrow \boxed{p = 3f}$

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{c} \Longrightarrow \boxed{l = \frac{3}{2} f}$$

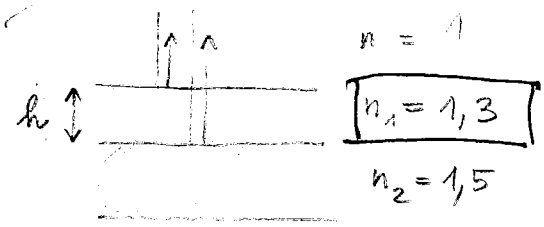
s slike: $\boxed{l = f + 2d}$

$$\Longrightarrow \boxed{d = \frac{f}{4}}$$

$$x = f + d = \frac{5}{4} \cdot f = \underline{\underline{3.75\ cm}}$$

Z namenom, da bi se zmanjšala odbojnost leč, se nanje nanaša tanek sloj prozornih snovi. Ocenite minimalno debelino takega sloja iz snovi z lomnim količmikom 1,3 , če hočete kar najbolj zmanjšati odbojnost leče za valovno dolžino λ = 550 nm ? Lomni količnik leče je 1,5.

$\lambda_0 = 550$ nm



pogoj za odbitek : $2 \cdot h_{min} = \frac{\lambda}{2}$,

$c = \frac{c_0}{n}$, $c = \nu \lambda$

$\lambda = \frac{\lambda_0}{n}$

$\Downarrow$

$h_{min} = \frac{\lambda_0}{4 \cdot n_1} = \underline{106 \text{ nm}}$

$n_1 = 1.2$: $h_{min} = 115$ nm

$n_1 = 1.3$: $h_{min} = 106$ nm

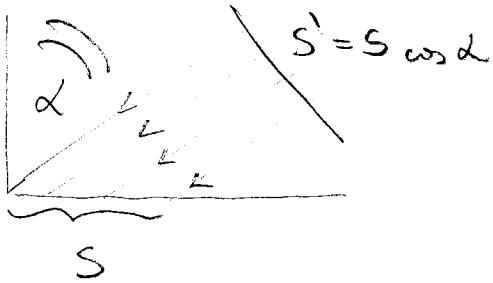
4

$[cd] = \frac{W}{ster}$

V višini 5 m nad sredino ravne ceste je neprekinjena veriga fluorescenčnih svetilk. Svetilnost 1 m dolgega odseka te verige je 80 cd. Kolikšna je osvetljenost sredine ceste? [W]

P = svetlobni tok

j = gostota svetlobnega toka $= \frac{P}{S'} = \frac{dP}{dS'}$



$S' = S\cos\alpha$

j' = osvetljenost $= \frac{P}{S}$

$$\boxed{j' = j \cdot \cos\alpha}$$

$$\boxed{h = 5\,m \qquad \left(\frac{dI}{dx}\right) = 80\,\frac{W}{ster \cdot m}}$$

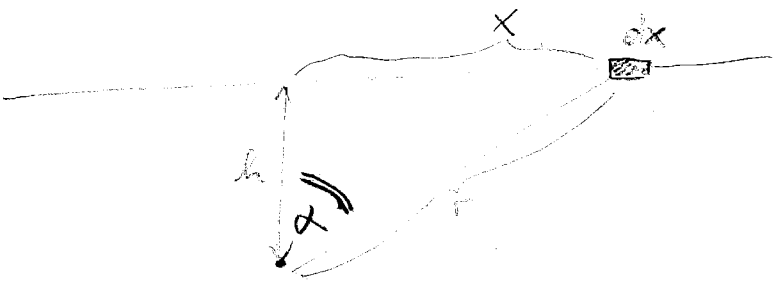
točkasto svetilo:

$$j = \frac{P}{S_r} = \frac{P}{4\pi r^2} = \frac{I}{r^2}$$

$$I = P/4\pi \,, \quad I = \frac{dP}{d\Omega}$$

$\Omega = \frac{S}{r^2} \equiv$ prostorski kot

$I \equiv$ svetilnost



$$dj' = \frac{dI}{r^2}\cos\alpha \Rightarrow j' = \int \frac{dI}{r^2}\cos\alpha$$

$$\boxed{tg\,\alpha = \frac{x}{h}} \Rightarrow \boxed{\frac{1}{\cos^2\alpha}\,d\alpha = \frac{dx}{h}}$$

$$j' = \int_{-\infty}^{+\infty} \frac{(dI/dx)\,dx}{r^2} \cdot \cos\alpha =$$

$$\boxed{\cos\alpha = \frac{h}{r}} \Rightarrow \boxed{r^2 = h^2/\cos^2\alpha}$$

$$= \int_{-\pi/2}^{+\pi/2} \frac{(dI/dx)\,d\alpha \cdot h \cdot \cos^3\alpha}{h^2 \cdot \cos^2\alpha} = \frac{(dI/dx)}{h}\int_{-\pi/2}^{+\pi/2} \cos\alpha\,d\alpha = \frac{(dI/dx)}{h}\sin\alpha\Big|_{-\pi/2}^{+\pi/2} =$$

$$= \frac{2\,(dI/dx)}{h} = 32\,\frac{W}{m^2}$$

$h = 4\,m \rightarrow j' = 40\,\frac{W}{m^2}$

5

itd.p
npit 1993

OP12

Krožno polarizirana svetloba valovne dolžine 600 nm pada pravokotno na dvolomno ploščico. Glavna lomna količnika sta 1,504 in 1,516. Kolikšna mora biti debelina ploščice, da je prepuščena svetloba linearno polarizirana?

(Optična os leži v ravnini ploščice)

$n_r = 1{,}504$ (rona)

$n_i = 1{,}516$ (izredni)

$\lambda = 600\ nm$

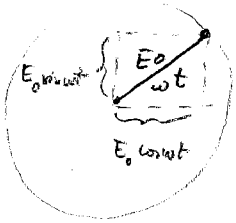
dvojni lom je v anizotropnih kristalih

krožna pol. valovanje:

$$E_x = E_0 \cos(\omega t) = E_0 \sin\left(\omega t + \frac{\pi}{2}\right)$$

$$E_y = E_0 \sin(\omega t)$$

$$E_x^2 + E_y^2 = E_0^2$$

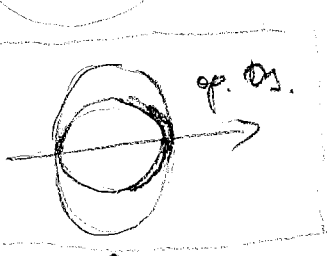


če hočes lin. pol. svetlobo (t.j. E_x in E_y v fazi)

⇓

en žarek zakasniti mora glede na drugega

TLORIS



vpadni curek

$$\boxed{t_r = \frac{d}{c_r}} \quad / \quad \boxed{t_i = \frac{d}{c_i}}$$

$$\omega(t_i - t_r) = \frac{\pi}{2}$$

$$\frac{\omega d}{c_i} - \frac{\omega d}{c_r} = \frac{\pi}{2} \quad / \quad \boxed{c_r = \frac{c_0}{n_r}} \quad / \quad \boxed{c_i = \frac{c_0}{n_i}}$$

$$\frac{\omega d n_i}{c_0} - \frac{\omega d n_r}{c_0} = \frac{\pi}{2}$$

$$c_0 = \nu\lambda$$

$$2\pi c_0 = 2\pi\nu \cdot \lambda = \omega\lambda \Rightarrow \frac{\omega}{c_0} = \frac{2\pi}{\lambda}$$

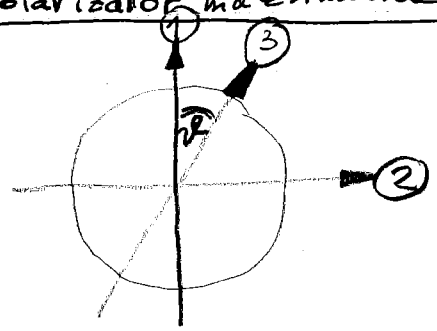
$$\frac{2\pi}{\lambda}(n_i - n_r)\, d = \frac{\pi}{2}$$

⇓

$$\boxed{d = \frac{\lambda}{4} / (n_i - n_r) = 12{,}5\ \mu m}$$

Izpit 1997

5. Dve polaroidni plošči imata medsebojno pravokotni osi polarizacije, medtem ko je os tretje polaroidne plošče, ki se nahaja med njima, nagnjena za kot ϑ od osi prvega polaroida. Pravokotno na prvi polaroid pade snop linearno polarizirane svetlobe tako, da ravnina polarizacije vpadne svetlobe oklepa kot ϑ z polarizacijsko osjo prvega polarizatorja. Določite za kateri kot ϑ je intenziteta svetlobe, ki ~~izhaja iz tretjega polarizatorja maksimalna?~~ pride skozi vse tri polarizatorje maksimalna? FU



$$I_1 = I_0 \cos^2\vartheta$$

$$I_2 = I_1 \cos^2\vartheta = I_0 \cos^4\vartheta$$

$$I_3 = I_2 \cos^2\left(\frac{\pi}{2}-\vartheta\right) = I_0 \cos^4\vartheta \cos^2\left(\frac{\pi}{2}-\vartheta\right)$$

$$\frac{\partial I_3}{\partial \vartheta} = I_0\left\{-4\cos^3\vartheta \sin\vartheta \cos^2\left(\frac{\pi}{2}-\vartheta\right) + \cos^4\vartheta\, 2\cos\left(\frac{\pi}{2}-\vartheta\right)\sin\left(\frac{\pi}{2}-\vartheta\right)\right\} =$$

$$= I_0\left\{-4\cos^3\vartheta \sin^3\vartheta + 2\cos^5\vartheta \sin\vartheta\right\} = 0$$

$$\Downarrow$$

$$\frac{\cos^3\vartheta \cdot \sin^3\vartheta}{\cos^5\vartheta \sin\vartheta} = \frac{1}{2}$$

$$\boxed{tg^2\vartheta = \frac{1}{2}} \Rightarrow \boxed{tg\,\vartheta = \frac{1}{\sqrt{2}}}$$

$$\Downarrow$$

$$\boxed{\vartheta = 35{,}26^\circ}$$ O.K.

$$\cos\left(\frac{\pi}{2}-\vartheta\right) = \cos\frac{\pi}{2}\cos\vartheta + \sin\frac{\pi}{2}\sin\vartheta = \sin\vartheta$$

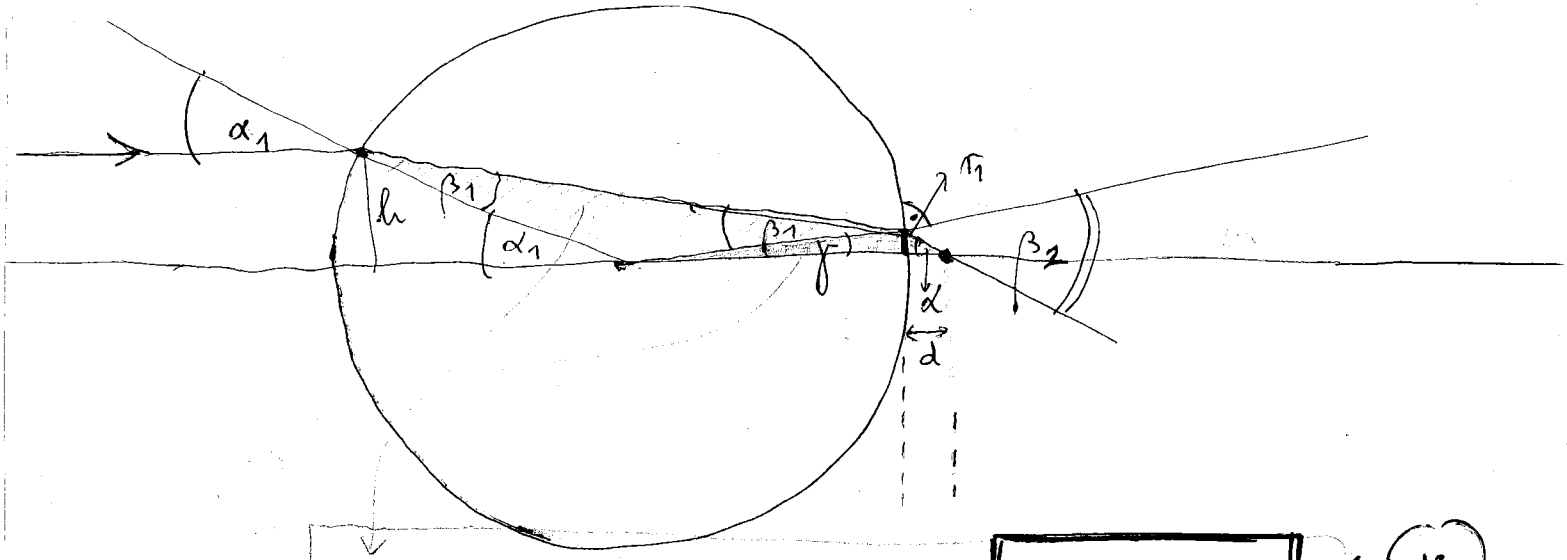
$$\sin\left(\frac{\pi}{2}-\vartheta\right) = \sin\frac{\pi}{2}\cos\vartheta - \sin\vartheta\cos\frac{\pi}{2} = \cos\vartheta$$

A-L

1992

2. Ozek snop paralelnih svetlobnih žarkov pade navpično na stekleno kroglo z radijem R= 10 cm. Koliko cm od nasprotne površine krogle fokusira omenjeni svetlobni snop, če je lomni količnik stekla n= 1,52 ?

$R = 0{,}1\,m$
$n = 1{,}5$
$d = ?$



$$2\beta_1 + (180 - \alpha_1 - \gamma) = 180 \Rightarrow \boxed{2\beta_1 - \alpha_1 = \gamma} \leftarrow (\gamma)$$

$\alpha + \gamma + (180 - \beta_2) = 180$

$$\boxed{\alpha = \beta_2 - \gamma} \{\text{iz slike}\} \Rightarrow \boxed{\alpha = \beta_2 - 2\beta_1 + \alpha_1} \leftarrow (\alpha)$$

$$\boxed{\operatorname{tg}\alpha = \frac{r_1}{d}} \quad \boxed{\sin\gamma = \frac{r_1}{R}} \Rightarrow r_1 = R\sin\gamma$$

$$\Downarrow$$

$$\operatorname{tg}\alpha = \frac{r_1}{d} = \frac{R\sin\gamma}{d} \Rightarrow \boxed{d = \frac{R\sin\gamma}{\operatorname{tg}\alpha} = \frac{R\sin(2\beta_1 - \alpha_1)}{\operatorname{tg}(\beta_2 - 2\beta_1 + \alpha_1)}}$$

LOMNI ZAKON $\boxed{\frac{\sin\alpha_1}{\sin\beta_1} = n \approx \frac{\alpha_1}{\beta_1}}$ $\boxed{\frac{\sin\beta_2}{\sin\beta_1} = n \approx \frac{\beta_2}{\beta_1}} \Rightarrow \boxed{\alpha_1 = \beta_2}$

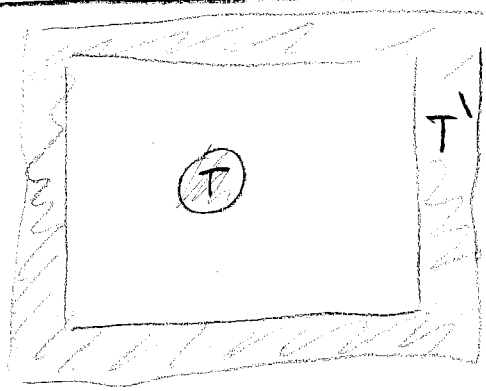
$\sin\varphi \approx \varphi$
$\operatorname{tg}\varphi \approx \varphi$

$$d = \frac{R\sin(2\beta_1 - \alpha_1)}{\operatorname{tg}(\alpha_1 - 2\beta_1 + \alpha_1)} = \frac{R\sin(2\beta_1 - \alpha_1)}{\operatorname{tg}(2\alpha_1 - 2\beta_1)} \approx$$

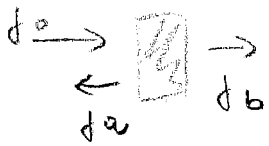
$$\approx \frac{R(2\beta_1 - \alpha_1)}{2\alpha_1 - 2\beta_1} = \frac{R\left(2\frac{\alpha_1}{n} - \alpha_1\right)}{2\alpha_1 - 2\frac{\alpha_1}{n}} = \frac{R\left(\frac{2}{n} - 1\right)}{2\left(1 - \frac{1}{n}\right)} =$$

$$= \underline{\underline{4{,}6\ cm}}$$

Str/525 Sivo telo z albedom 0.5 damo v evakuirano posodo, ki seva na notranji strani kot črno telo. Sivo telo ima površino 10 cm² in albedo 0.5. Posoda je potopljena v velik rezervoar s temperaturo $T' = 50°C$. Kolikšen je izsevani tok telesa v ravnovesju. (OP11)



$T' = konst.$



albedo ali odbojnost $\boxed{a = \frac{j_a}{j_0}}$

podatki
$$\begin{cases} T' = 50°C = 323\,K \\ a = 0{,}5 \\ S = 10\,cm^2 \\ \sigma = 5{,}67 \cdot 10^{-8}\ W/m^2K^4 \end{cases}$$

vpadni tok:	$\sigma T'^4 \cdot S$
odbiti tok:	$a \cdot \sigma T'^4 \cdot S$
absorbirani tok:	$(1-a)\sigma T'^4 \cdot S$

v ravnovesju:

$\boxed{T' = T}$

če načeš, da teče toplota

abs. tok = izsevani tok

$$\Downarrow$$

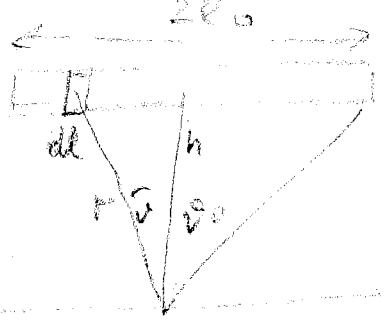
$$P = (1-a)\sigma T^4 \cdot S =$$

100 W/m² Kolokvij 90/91 **OP5**

3. 2 m visoko nad mizo je 1 m dolga valjasta svetilka s premerom 3 cm. Njena svetlost je [redacted] cd/m². Kolikšna je osvetljenost mize? Pri računanju zanemarimo odboj svetlobe od stropa in sten.

N-8

Det. 4/7



pod središčem svetilke

$\ell_0 = 0.5\ m$
$a = 0.015\ m$
$h = 2\ m$
$B = 100\ W/m^2$

$tg\,\vartheta_0 = \ell_0/h = 0.5/2 = 0.25 \Rightarrow \vartheta_0 = 14.036$

$\cos\vartheta = \frac{h}{r}$, $tg\,\vartheta = \frac{\ell}{h} \Rightarrow d\ell = \frac{h}{\cos^2\vartheta}\cdot d\vartheta$

$dI' = \frac{dI}{r^2}\cos\vartheta = \frac{B\,2a\,d\ell}{r^2}\cdot\cos\vartheta =$

$= \frac{2aB\cos^2\vartheta\cdot\cos\vartheta\cdot h}{h^2\cos^2\vartheta}\,d\vartheta =$

$= \frac{2aB}{h}\cos\vartheta\,d\vartheta$, $dj = dj'\cdot\cos\vartheta$

$dj = \left(\frac{2aB}{h}\right)\cos^2\vartheta\,d\vartheta$

$j = 2\cdot\left(\frac{2aB}{h}\right)\int_0^{\vartheta_0}\cos^2\vartheta\,d\vartheta = \frac{2aB}{h}\int_0^{\vartheta_0}(1+\cos 2\vartheta)\,d\vartheta$

$= \cos(2\vartheta)\,d(2\vartheta)$

$= \left(\frac{aB}{h}\right)(2\vartheta_0 + \sin 2\vartheta_0)$

$\frac{0.015\cdot\cdot 100}{2}\left(2\cdot 14.036\cdot\frac{\pi}{180} + \sin 28.072\right)\ lx = \frac{W}{m^2}$

0.4207

0.96

$j = 0.72\ \left[\frac{W}{m^2} \equiv lx\right]$

osvetljenost $j = j_0\cos\vartheta$

$I = B\cdot S' = B\cdot S\cos\vartheta_0$

svetlost svetlost

točkasto svetilo:

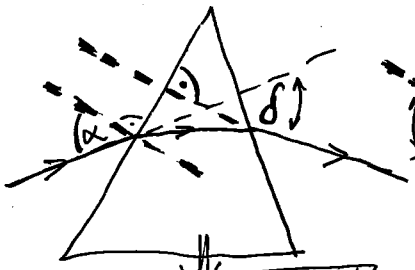
$j = \frac{P}{S} = \frac{P}{4\pi r^2} = \frac{I}{r^2}$, $\frac{P}{4\pi} = I$

$\cos 2\vartheta = \cos^2\vartheta - \sin^2\vartheta$
$= \cos^2\vartheta - (1-\cos^2\vartheta)$
$= 2\cos^2\vartheta - 1$

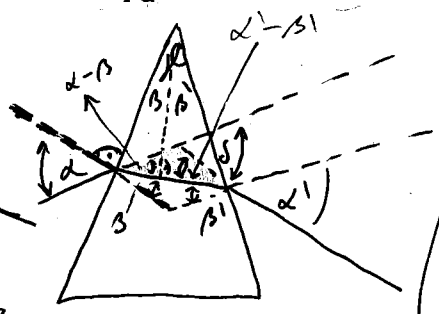
$\cos^2\vartheta = \frac{1+\cos 2\vartheta}{2}$

$cd \equiv \frac{W}{sterad}$

2. Paralelni snop bele svetlobe pada na prizmo z lomečim kotom $\gamma = 45^\circ$ pod takim kotom glede na površino prizme, da zapušča rdeči snop svetlobe prizmo pod pravim kotom glede na površino prizme na drugi strani. Za koliko sta na 10 m oddaljenem zaslonu oddaljeni lisi rdeče in vijoličaste svetlobe ? Lomni količnik prizme za rdečo svetlobo $n_{rd} = 1,37$, lomni količnik prizme za vijoličasto sv. 1992



$\alpha = \delta$



$\delta = \alpha - \beta + \alpha' - \beta' = \alpha + \alpha' - \gamma$

(1) $\delta = \alpha + \alpha' - \gamma$

(2) $\gamma = \beta + \beta'$

(3) $\frac{\sin\alpha}{\sin\beta} = n$

(4) $\frac{\sin\alpha'}{\sin\beta'} = n$

$180 = (\alpha - \beta) + (\alpha' - \beta') + (180 - \delta)$

$\gamma = 45^\circ$

RDEČA

$\alpha = \delta$ (1) $\Rightarrow$ $\delta = \delta + \alpha' - \gamma$ $\Leftarrow$ (1)

$\alpha'_{rd} = 45^\circ$

$\alpha' = \gamma = 45^\circ$ $\quad \alpha' = 45$

$n_{rd} = 1.37$

$\sin\beta' = \frac{\sin\alpha'}{n} = \frac{\sin\alpha'}{1.37}$

$\beta' = 31,07$

(2) $\beta = \gamma - \beta' = 13,93$

(3) $\sin\alpha = 1.37 \cdot \sin\beta$ $\Longrightarrow$ $\alpha = 18.25^\circ$

VIJOLIČASTA

$\alpha = 18.25^\circ$ $\quad \alpha' = ?$

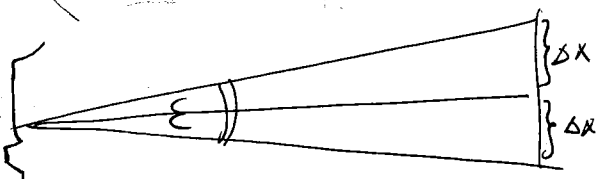
$n = 1,42$

$\sin\beta = \frac{\sin\alpha}{n} = 0.23 \Rightarrow \beta = 13.326^\circ$

(2) $\Rightarrow$ $\beta' = 45^\circ - \beta$ $\Longrightarrow$ $\beta' = 31,57^\circ$

(4) $\Rightarrow$ $\sin\alpha' = n \cdot \sin\beta' = 0.743 \Longrightarrow \alpha'_{vi} = 48.029^\circ$

REZULTAT



$\varepsilon = \alpha'_{vi} - \alpha'_{cr} = 3,029 \Rightarrow \frac{\varepsilon}{2} = 1.5145$

$tg\left(\frac{\varepsilon}{2}\right) = \frac{\Delta x}{10\,m} \Rightarrow 2\Delta x = 2 \cdot 10\,m \cdot tg\left(\frac{\varepsilon}{2}\right) = 52,94$

1. Slika predmeta, ki je oddaljen 10 m od ~~objektiva fotoaparata~~ zbiralne leče je ~~na filmu~~ visoka 3 cm. Če je isti predmet oddaljen 6 m, pa je njegova slika visoka 5,02 cm. Kolikšna je višina predmeta? ~~kiseg fotoaparata~~? F2

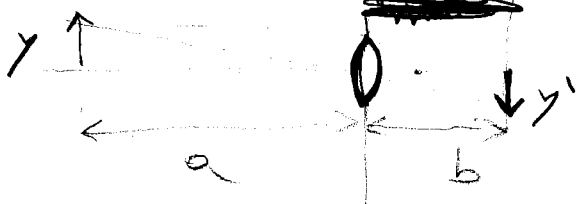
[redacted]

$a_1 = 10\ m$

$y_1' = 0{,}03\ m$

$a_2 = 6\ m$

$y_2' = 0{,}0502\ cm$



$\{y, b_1, b_2, f\} = ?$

$$\boxed{\frac{y}{a_1} = \frac{y_1'}{b_1}} \quad \boxed{\frac{y}{a_2} = \frac{y_2'}{b_2}} \quad \boxed{\frac{1}{a_1} + \frac{1}{b_1} = \frac{1}{f}} \quad \boxed{\frac{1}{a_2} + \frac{1}{b_2} = \frac{1}{f}}$$

$$\frac{1}{a_1} + \frac{1}{b_1} = \frac{1}{a_2} + \frac{1}{b_2}$$

$$\Downarrow$$

$$\frac{1}{b_1} = \frac{1}{a_2} + \frac{1}{b_2} - \frac{1}{a_1}$$

$$\frac{1}{b_2} = \frac{y}{y_2'}\frac{1}{a_2}$$

$$\frac{y}{a_1} = y_1'\left(\frac{1}{a_2} + \frac{1}{b_2} - \frac{1}{a_1}\right)$$

$$\Downarrow$$

$$y = y_1'\frac{a_1}{a_2} + a_1 y_1'\frac{y}{y_2'}\frac{1}{a_2} - y_1'$$

$$y\left(1 - \frac{y_1'}{y_2'}\frac{a_1}{a_2}\right) = y_1'\left(\frac{a_1}{a_2} - 1\right)$$

$$\Downarrow$$

$$\boxed{y = y_1'\frac{\left(\frac{a_1}{a_2} - 1\right)}{\left(1 - \frac{y_1'}{y_2'}\frac{a_1}{a_2}\right)} \cong 5\ m}$$

$f \cong 0{,}06\ m$

16.) *Objektiv in okular mikroskopa sta oddaljena za 20 cm, goriščna razdalja objektiva $f = 4$ mm, goriščna razdalja okularja $f' = 5$ mm. Kolikšna je razdalja predmeta od objektiva in kolikšna je povečava?*

(4,1 mm, ~ 2400 kratna)

$f + f' + x' = 0{,}2\ m \Rightarrow x' = 0{,}191\ m$, $b = f + x'$

$f = 0{,}004\ m$

$f' = 0{,}005\ m$

$a_0 = 0{,}25\ m$

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f} \Rightarrow \frac{1}{a} = \frac{1}{f} - \frac{1}{f + x'}$$

$$\boxed{a = 4{,}1\ mm}$$

$$N = \frac{a_0 \cdot x'}{f \cdot f'} = \underline{\underline{2388}}$$

Oko ne loči 0,1 mm

$\frac{0{,}1\ mm}{2388} = 4{,}2 \cdot 10^{-8}$

$\frac{\lambda}{2} = 7{,}7 \cdot 10^{-8}$

$\lambda = 750$ nm (maximum)

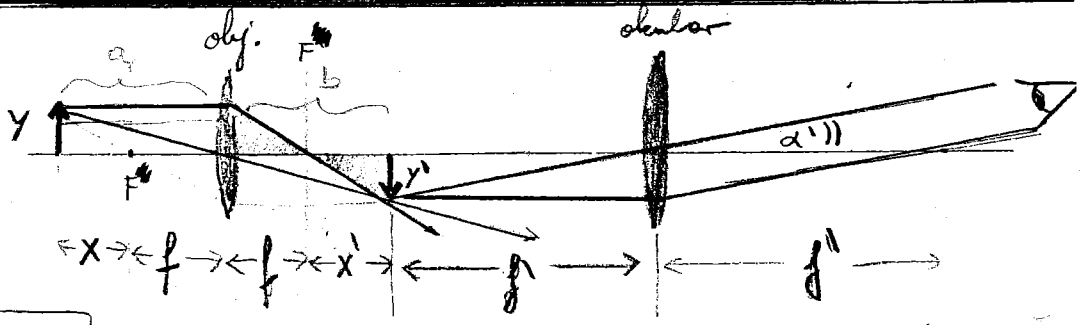
$R = 0{,}03$ m

Najmanjši delček, ki ga lahko vidimo, da bi ga ločili od ozadja, imenujemo ločljivost okularja. Ločljivost očesa je 0,1 mm. Kolikšna pa je ločljivost mikroskopa?

MIKROSKOP

$a_0 = 25$ cm

opazovanje s prostim očesom: $\boxed{tg\,\alpha = \frac{y}{a_0}}$

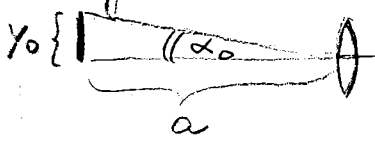


$$\boxed{tg\,\alpha' = \frac{y'}{f'} = \frac{y x'}{f \cdot f'}}$$

$$\boxed{y' = \left(\frac{x'}{f}\right) y} \Leftarrow \frac{y}{f} = \frac{y'}{x'_0}$$

$$\boxed{\text{povečava } N = \frac{tg\,\alpha'}{tg\,\alpha} = \frac{a_0 \cdot x'}{f \cdot f'}}$$

Ločljivost mikroskopa: $\alpha_0 \cong \frac{1}{2}\frac{\lambda}{R}$, $R \equiv$ radij objektiva



$$tg\,\alpha_0 = \frac{y_0}{a} \approx \alpha_0 = \frac{1}{2}\frac{\lambda}{R} \Rightarrow \boxed{y_0 = \frac{1}{2}\lambda \cdot \left(\frac{a}{R}\right)}$$

najmanjša razdalja med dvema točkama

Fizika II | 1. letnik | KR/215/370 in OPZ | 1. p. test. 1991 |

W/steradian

1 W → 680 lm

1 lm → $\frac{1}{680}$ W

1 cd = $\frac{lm}{ster}$ = → $\frac{W}{680\ ster}$

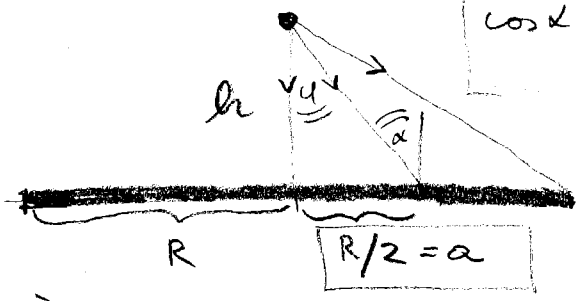
$\frac{lm}{m^2} = 1\ lx$

1. Svetilka svetilnosti 200 je obešena nad sredino okrogle mize tako, da je osvetljenost meze na polovični razdalji med središčem mize in njenim robom maksimalna. Največ kolikšen sme biti premer mize, da osvetljenost na njenem robu ni manjša od 50 W/m^2.

$$I = 200\ \frac{W}{steradian}$$

$$j'_R = 50\ W/m^2$$

$$\cos\alpha = \frac{h}{\sqrt{a^2+h^2}} = \frac{h}{r}$$



$$j'_a = \frac{I}{r^2}\cos\alpha = \frac{I}{a^2+h^2}\cdot\frac{h}{\sqrt{a^2+h^2}} \Rightarrow$$

$$\boxed{j'_a = \frac{I h}{(a^2+h^2)^{3/2}}} \qquad \boxed{\frac{dj'_a}{dh} = 0} \Rightarrow \boxed{h = \frac{a}{\sqrt{2}}} \Rightarrow \boxed{h = \frac{R}{2\sqrt{2}}}$$

$$j'_R = \frac{I h}{(R^2+h^2)^{3/2}} = \frac{I R}{2\sqrt{2}\left(R^2+\frac{R^2}{4\cdot 2}\right)^{3/2}} =$$

$$= \frac{I R}{2\sqrt{2}\left(R^2+R^2/8\right)^{3/2}} = j'_R \Rightarrow$$

$$tg\,\varphi = \frac{R/2}{h} = \frac{R\,2\sqrt{2}}{2R} = \sqrt{2}$$

$$\varphi = 54$$

$$I R = j'_R\, 2\sqrt{2}\left(\frac{9\cdot R^2}{8}\right)^{3/2} = j'_R\cdot 2\sqrt{2}\cdot\left(\frac{9}{8}\right)^{3/2}\cdot R^3 \quad /:R$$

$$I = j'_R\cdot 2\cdot\sqrt{2}\cdot\left(\frac{9}{8}\right)^{3/2} R^2$$

$$R = \sqrt{\frac{I}{j'_R\cdot 2\cdot\sqrt{2}\cdot\left(\frac{9}{8}\right)^{3/2}}} = \sqrt{\frac{200}{50\cdot 2\cdot\sqrt{2}\cdot\left(\frac{9}{8}\right)^{3/2}}} = 1.0886\ m$$

$I = 200\ \frac{W}{ster}$ $\boxed{R = 1.09\ m}$

$$\left\{\begin{array}{l} j_R = 50\ lx = 50\ \frac{lm}{m^2} \\ I = 200\ cd = 200\ \frac{lm}{ster} \end{array}\right\} \boxed{R = 1{,}09\ m}$$

$I = 200\ cd \rightarrow \frac{200\ W}{680\ ster} \Rightarrow \boxed{R = 0{,}042\ m}$

Šolski izv. 80/81

P ≡ mtl, tok

OP3

5. Absorpcijski koeficient vode za sončno svetlobo je 0,03 m^{-1}. Pravokotno na morsko gladino pada sončna svetloba z gostoto toka 1 kW/m^2. Koliko svetlobne energije se absorbira v eni uri v 1 kg vode tik ob gladini morja in koliko svetlobne energije se absorbira v eni uri v 1 kg vode 30 m pod morsko gladino ? (A-M)

$P = \frac{w \cdot V}{t}$

Str. 96/23

$j = \frac{P}{S} = \frac{w}{S \cdot t} = w \cdot c$

$dj = -j\mu\, dz \Rightarrow j = j_0 e^{-\mu z}$

$\mu = 0.03\ m^{-1}$

$j = 1\ kW/m^2$

$j(z+dz) - j(z) = dj$ (absorbirana m.)

$-\frac{S\, dj \cdot t}{dV} = \frac{j\mu\, dz \cdot S \cdot t}{dV} = \frac{j\mu\, dz \cdot S \cdot t}{S \cdot dz}$

$dV = S \cdot dz$

$dW = dw\, V = dj \cdot S\, t$

$w_{abs} = j\mu t = j_0 e^{-\mu z} \mu \cdot t$

A) $z = 0 \Rightarrow w_A = 1 \cdot e^0 \cdot 0.03 \cdot 3600 \left(\left[\frac{kW}{m^2} \cdot \frac{1}{m} \cdot s \right] = \frac{kJ}{m^3} \right)$

$= 108\ kJ/m^3$

B) $z = 30m \Rightarrow w_B = 1 \cdot e^{-0.03 \cdot 30} \cdot 0.03 \cdot 3600 =$

$= 43.9\ kJ/m^3$

A-L

1992

6. Točkasti svetili sevata monokromatsko svetlobo. Svetili sta na višini 60 cm nad ravno mizo razmaknjeni za 60 cm. Amplituda jakosti električnega polja svetlobe prvega svetila na razdalji 10 cm od svetila je 50 V/m. Kolikšna je svetilnost (I_2) drugega svetila, če je miza najmočneje osvetljena na razdalji 15 cm od od vznožišča prvega svetila v smeri proti vznožišču drugega svetila ? Absorpcijo svetlobe zanemarimo. $\varepsilon_0 = 8{,}85 \cdot 10^{-12}\,As/Vm$

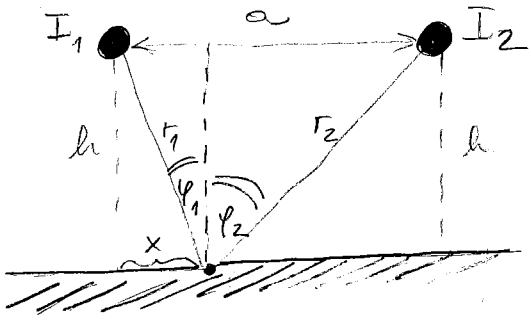
$h = 0{,}6\,m$
$a = 0{,}6\,m$
$\tilde{E}_1(r = 0{,}1\,m) = \frac{50\,V}{m}$
$x = 0{,}15\,m$
$r = 0{,}1\,m$

M-Ž

1992

5. Točkasti svetili sevata monokromatsko svetlobo. Svetili sta na višini 50 cm nad ravno mizo razmaknjeni za 50 cm. Amplituda jakosti električnega polja svetlobe prvega svetila na razdalji 10 cm od svetila je 50 V/m. Kolikšna je svetilnost (I_2) drugega svetila, če je miza najmočneje osvetljena na razdalji 15 cm od od vznožišča prvega svetila v smeri proti vznožišču drugega svetila ? Absorpcijo svetlobe zanemarimo.

$h = 0{,}5\,m$
$a = 0{,}5\,m$
$\tilde{E}_1(r = 0{,}1\,m) = \frac{50\,V}{m}$
$x = 0{,}15\,m$
$r = 0{,}1\,m$



$$j = w \cdot c = \frac{1}{2}\varepsilon_0 E_1^2 \cdot c = \frac{P_1}{4\pi r^2} = \frac{I_1}{r^2}$$

$$\boxed{I_1 = \frac{1}{2}\varepsilon_0 \tilde{E}_1^2 \cdot c \cdot r^2}$$

$$E = I_1 \cos\varphi_1 / r_1^2 + I_2 \cos\varphi_2 / r_2^2 =$$

$$= I_1 h \left(h^2 + x^2\right)^{-3/2} + I_2 h \left(h^2 + (a-x)^2\right)^{-3/2}$$

$r_1 = \sqrt{h^2 + x^2}$

$r_2 = \sqrt{h^2 + (a-x)^2}$

$\cos\varphi_1 = h / r_1, \quad \cos\varphi_2 = \frac{h}{r_2}$

maks. osvetljenost : $\boxed{dE/dx = 0}$

$$I_1 \cdot (h^2 + x^2)^{-5/2} \cdot x + I_2 \cdot \left(h^2 + (a-x)^2\right)^{-5/2} (a - x) = 0$$

$$\boxed{I_2 = \frac{x \cdot I_1}{(a-x)} \left[\frac{h^2 + (a-x)^2}{h^2 + x^2}\right]^{5/2}}$$

A-L $\quad I_1 = 3{,}32 \cdot 10^{-2}\,W, \quad \underline{I_2 = 2{,}9 \cdot 10^{-2}\,W}$ 1992

M-Ž $\quad I_1 = 3{,}32 \cdot 10^{-2}\,W, \quad \underline{I_2 = 3{,}1 \cdot 10^{-2}\,W}$ 2001

(1) FOR 26. 5. 98 1998 FOR

1. Dolgo počrnjeno žico z radijem 10 mm in s specifično upornostjo $\rho = 0.098\ \Omega mm^2/m$ grejemo z električnim tokom. Če je žica v vakuumu, je temperatura na njenem površju 1200 K. Kolikšen električni tok teče skozi žico ?

$r_0 = 10$ mm

$\xi = 0{,}098\ \Omega\, mm^2/m$, $T_0 = 1200$ K (železo, pločlo → snov)

$$P_R = P_\sigma$$

$$I^2 R = \sigma T_0^4 \cdot S$$

$$\frac{I^2 \xi l}{S_0} = \sigma T_0^4 \cdot S$$

$$\frac{I^2 \xi l}{\pi r_0^2} = \sigma T_0^4\, 2\pi r_0 l$$

$P = IU = I^2 R$

$R = \frac{\xi l}{S}$

$S_0 = \pi r_0^2$

$S = 2\pi r_0 l$

$$\boxed{I = \left(\frac{\sigma T_0^4\, 2\pi^2 r_0^3}{\xi} \right)^{1/2}} = \underline{\underline{4{,}86\ kA}}$$

$$\left(\frac{5{,}67 \cdot \cancel{10^{-8}} \cdot 20736 \cdot \cancel{10^{8}}\, 2\pi^2 \cdot \cancel{10^{-6}}}{0{,}098 \cdot \cancel{10^{-6}}} \right)^{1/2}$$

<u>opomba</u>: Če dovolj visoka temperatura žice lahko zanemariš sevanji okolice!

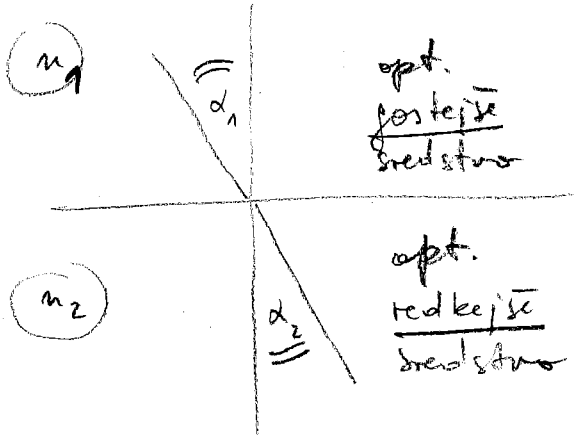
OP20

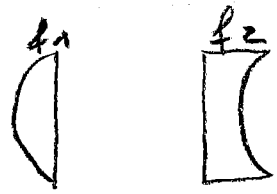
Kdaňovj FOR 1990

4. Plankonveksna in plankonkavna leča imata enaka krivinska radija (R=1,5 m). Zloženi v lečje imata dioptrijo 0,1 (0.4). Kolikšna sta lomna količnika stekel leč, če je mejni kot ~~[illegible]~~ popolnega odboja pri prehodu žarka iz ene leče v drugo 60°?

$n_1 = 1{,}12$

$n_2 = 0{,}94$



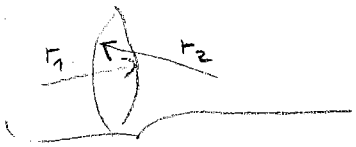


$R = 1{,}5\ m$

$$\boxed{n_1 > n_2}$$

$$\frac{\sin\alpha_1}{\sin\alpha_2} = \frac{n_2}{n_1}, \quad \text{tot. odboj} \quad \frac{\sin 60}{1} = \frac{n_2}{n_1} \Rightarrow \boxed{\frac{n_2}{n_1} = \sin 60^\circ} \quad (1)$$

$$(2) \quad \boxed{\frac{1}{f_1} + \frac{1}{f_2} \cong 0.1} > 0 \Rightarrow \frac{1}{f_1} > \left|\frac{1}{f_2}\right|$$



$$\boxed{\frac{1}{f} = (n-1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right)}$$

plan konveksna leča:

$$\frac{1}{f} = (n-1)\cdot\frac{1}{r}$$

plan konkavna leča:

$$\frac{1}{f} = -(n-1)\cdot\frac{1}{|r|}$$

$$\boxed{\frac{1}{f_1} = +\left(\frac{1}{R}\right)\left[n_1 - 1\right]} \quad (3)$$

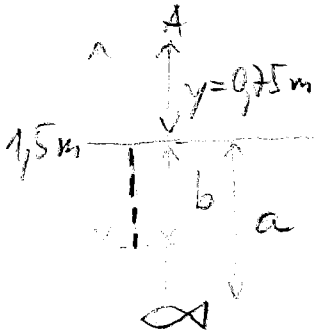
$$\boxed{\frac{1}{f_2} = -\left(\frac{1}{R}\right)\left[n_2 - 1\right]} \quad (4)$$

$$\underbrace{(1)\ (2)\ (3)\ (4)}$$

$$\Downarrow$$

$$\boxed{n_1,\ n_2,\ f_1,\ f_2}$$

5. S čolna fotografiramo jato rib, ki plava pod njim. Fotografski aparat leži 0,75 m nad gladino (ZELO ČISTEGA) jezera in je nastavljen na razdaljo 1,5 m. Na kateri globini so bile ribe, ki se na fotografiji vidijo najbolj ostro in so plavale točno pod aparatom ? Lomni količnik vode je 1,33. Upoštevaj, da so vsi koti majhni!



$\boxed{n = 1{,}33}$

$\beta, \alpha \to 0$

$$\frac{\sin\beta}{\sin\alpha} = n \Rightarrow \boxed{\beta = n\alpha}$$

$$\left.\begin{aligned} \operatorname{tg}\beta &= \frac{x}{b} \\ \operatorname{tg}\alpha &= \frac{x}{a} \end{aligned}\right\} \Rightarrow \boxed{\beta = \frac{a}{b}\cdot\alpha}$$

$$\boxed{\frac{a}{b} = n}$$

$b = 0{,}75\ m$

$\underline{a = n \cdot b = 1\ m}$ $(0{,}9975\ m)$

elektrotehnika 1991

18. Monohromatska svetlost (λ = 500 nm) pada normalno na okrugli otvor sa promjerom 0,02 mm. Difrakcionu sliku osmatramo na zaklonu na rastojanju 1 m. Odrediti promjer centralne pege na zaklonu!

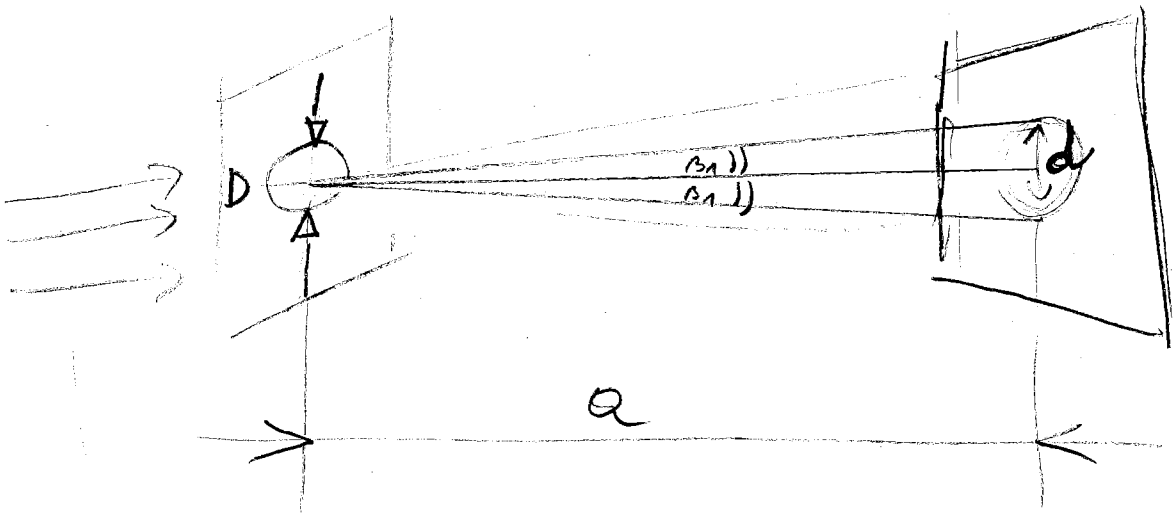
a) 6 cm
b) 3 cm
c) 4,3 cm
d) 7,2 cm
e) ni jedan od gornjih rezultata nije tačan

$a = 1\ m$
$\lambda = 500\ nm$
$2R = 0{,}02\ mm$
$d = ?$

KE/32/556

$$\boxed{\sin\beta_1 = 0{,}61 \cdot \frac{\lambda}{R}} = 0{,}03 \approx tg\,\beta_1$$

tem $\quad d = 2a \cdot tg\,\beta_1 = 2m \cdot 0{,}03 = 6\ cm$



najmanjši kot pri katerem je valovanje opaženo

V8

Naloga :
SB/221/6

Šolsko leto 90/91

VAL 7

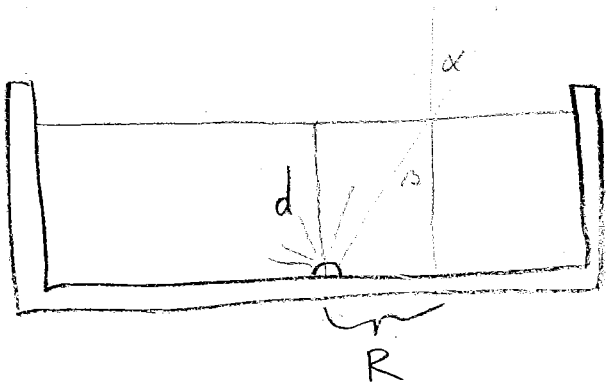
VAL

Majhna luč na dnu 1 m globokega bazena pošilja svetlobo enakomerno v vseh smereh. Na površini vode v bazenu nastane krog svetlobe, ki izhaja iz bazena. Izven tega kroga se svetloba lomi nazaj v vodo. Določi radij R omenjenega kroga svelobe. Lomni količnik vode je 1.33.

$d = 1\ m$

$n = 1.33$

$R = ?$



$$\frac{\sin\alpha}{\sin\beta} = \frac{c}{c'} = n = 1.33$$

kritičn β_c ki, ko ji $\alpha_c = 90 \Rightarrow \sin\alpha_c = 1$

torej:

$$\frac{1}{\sin\beta_c} = 1.33 \Rightarrow \sin\beta_c = \frac{1}{1.33} = 0.75$$

$$\Downarrow$$

$$\boxed{\beta_c = 48.6^\circ}$$

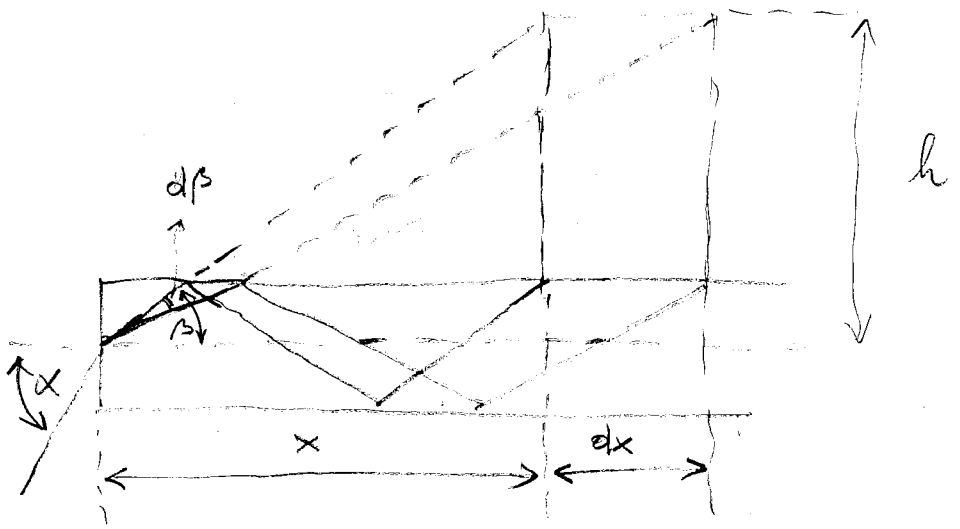
$$tg\,\beta_c = \frac{R}{d} \Rightarrow R = d \cdot tg\,\beta_c = 113\ cm$$

2. Na steklen valj z radijem 5 cm posvetimo s tankim curkom natrijeve svetlobe na sredino osnovne ploskve pod kotom 30° proti geometrijski osi. Lomni kvocient stekla je 1,5, njegova odvisnost od valovne dolžine svetlobe pa podaja enačba $\Delta n = -k \cdot \Delta\lambda$, $k = 2 \cdot 10^{5}\ nm^{-1}$. Natrijeva svetloba vsebuje dve enobarvni sestavini z valovnima dolžinama 589,0 nm in 589,6 nm. Kako dolg naj bo valj, da je razdalja med mestoma, kjer se žarka zadnjič odbijeta od stene valja, večja od 3 mm?

4.8.

$dx = 3\ mm$
$r = 5\ cm$
$\alpha = 30^{\circ}$
$n = 1{,}5$
$\Delta n = -k \cdot \Delta\lambda$
$k = 2 \cdot 10^{-5}\ nm^{-1}$
$\lambda_1 = 589\ nm$
$\lambda_2 = 589{,}6\ nm$

$x = ?$



$$\boxed{\frac{\sin\alpha}{\sin\beta} = n} \Rightarrow \sin\beta = \frac{\sin\alpha}{n} \Rightarrow \boxed{\cos\beta\, d\beta = -\sin\alpha \frac{dn}{n^2}} \quad (2)$$

$$\boxed{tg\beta = \frac{h}{x}} \Rightarrow \ln[tg\beta] = \ln\left[\frac{h}{x}\right] \Rightarrow \frac{d\beta}{tg\beta} \cdot \frac{1}{\cos^2\beta} = -\frac{x}{h}\frac{h}{x^2}\, dx \Rightarrow \boxed{\frac{d\beta}{(tg\beta \cdot \cos^2\beta)} = -\frac{dx}{x}} \quad (3)$$

Enačiš izraza za $d\beta$ (2) in (3) $\Rightarrow \frac{\sin\alpha}{\cos\beta}\frac{dn}{n^2} = tg\beta \cdot \cos^2\beta \frac{dx}{x} \Longrightarrow$

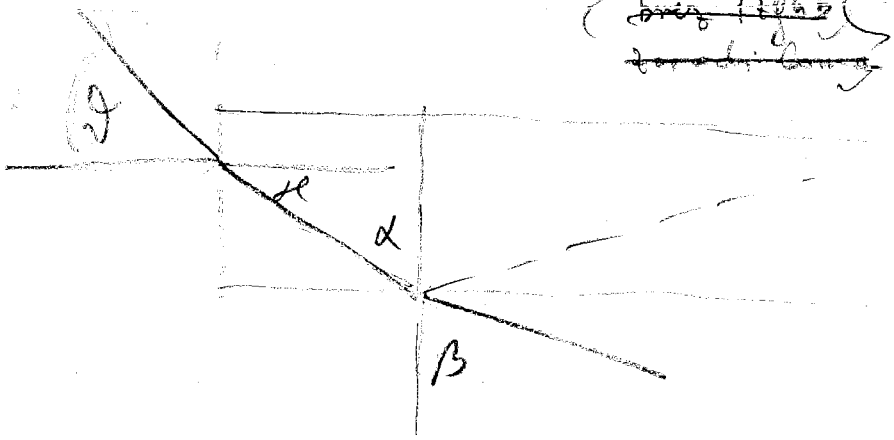
$$\Rightarrow x = \frac{\sin\beta}{\sin\alpha}\cos^2\beta \frac{dx}{dn} n^2 = \frac{1}{n}\left(1 - \frac{\sin^2\alpha}{n^2}\right) n^2 \frac{dx}{dn} = (n^2 - \sin^2\alpha) \cdot n \cdot dx / dn$$

$$\boxed{x = -(n^2 - \sin^2\alpha) \cdot n \cdot dx / (k \cdot d\lambda) = 333\ m}$$

$d\lambda = -0{,}6\ nm \Rightarrow dn > 0$

kolokvij 98/99 (OP17)

4. Pod kakšnim največjim kotom lahko pada svetloba ~~v valovni vodnik (optično~~ vlakno), da se bo še lahko širila po njem ? (lomni ~~koeficient~~ vodnika je 1.5.



$n = 1.5$

$n = \frac{c_0}{c}$

$$\frac{\sin\alpha}{\sin\beta} = \frac{1}{n}$$

$\beta = 90^\circ \Rightarrow \sin\beta = 1$

$$\sin\alpha_\perp = \frac{1}{n} \Rightarrow \alpha = 90 - \mu$$

$$\mu = 90 - \alpha$$

totalni odboj $\alpha_\perp \geq 41.8 \Rightarrow \mu \leq 48.2$

$$\alpha_{max} = 90^\circ$$

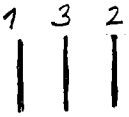
A-L

1992

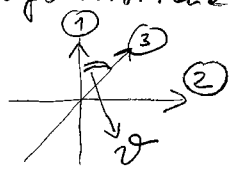
3. Dve polaroidni stekli sta postavljeni tako, da ne prepuščata svetlobe. Med njiju postavimo tretje polaroidno steklo, tako da skozi vsa tri stekla preide 9,4 % intenzite popolnoma nepolarizirane svetlobe. Za kolikšen kot je prepusta smer tega tretjega vmesnega stekla negnjena glede na smer polarizacije svetlobe, ki jo prepušča prvo steklo? Absorpcijo svetlobe v steklih zanemarimo.

$$\left(\frac{I}{I_0}\right)_{132} = 0{,}094$$

$$\frac{I}{I_0} = \cos^2\vartheta$$



nepolarizirana svetloba: $\overline{\cos^2\vartheta} = \frac{1}{2}$



$$\left(\frac{I}{I_0}\right)_{132} = \frac{1}{2}\cos^2\vartheta\cos^2\left(\frac{\pi}{2}-\vartheta\right) =$$

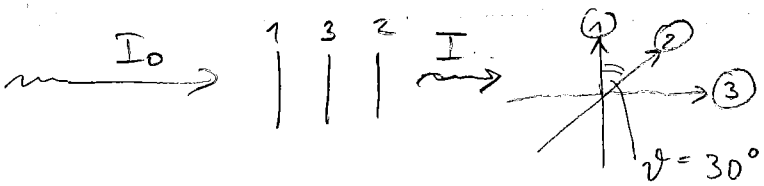
$$= \frac{1}{2}\cos^2\vartheta\sin^2(\vartheta) = \frac{1}{2}\cdot\frac{1}{4}\sin^2(2\vartheta) = 0{,}094 \Rightarrow$$

$$\Rightarrow \boxed{\vartheta = 30^\circ}$$

M-Ž

1992

4. Dve polaroidni stekli sta postavljeni tako, da ne prepuščata svetlobe. Med njiju postavimo tretje polaroidno steklo tako, da je njegova prepustna smer polarizacije za kot $\vartheta = 30^\circ$ nagnjena glede na smer polarizacije svetlobe, ki jo prepušča prvo steklo. Kolikšen del intenzite popolnoma nepolarizirane svetlobe bo prešel skozi vsa tri stekla ? Absorpcijo svetlobe v steklih zanemarimo.



$$\left(\frac{I}{I_0}\right)_{132} = \frac{1}{2}\cdot\cos^2\vartheta\cdot\cos^2\left(\frac{\pi}{2}-\vartheta\right) = \underline{0{,}094} = 9{,}4\,\%$$

FOR 96

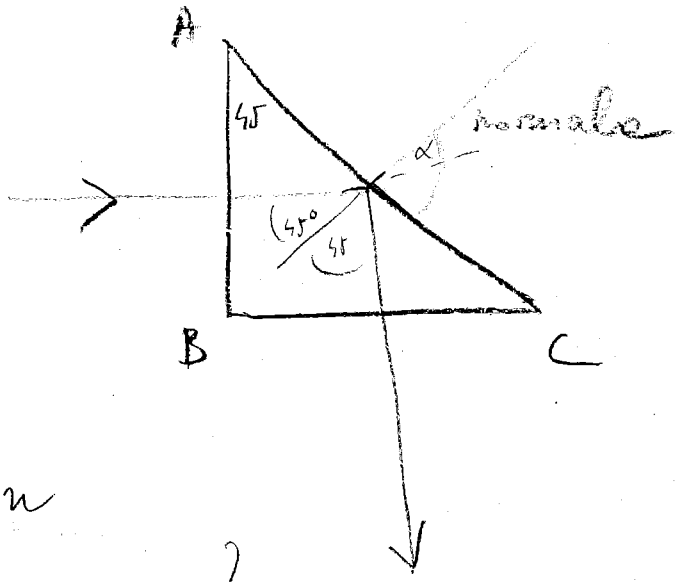
V11

VAL

VAL 10

Naloga : SB/221/8

Kakšna je minimalna vrednost lomnega količnika 45 ^{o} prizme ABC, ki jo uporabljamo za spremembo smeri curka svetlobe za 90° ?



$$\frac{\sin\alpha}{\sin\beta} = n$$

$$\left.\begin{array}{l}\alpha = 90^{\circ}\\ \beta = 45^{\circ}\end{array}\right\} \Rightarrow n = \frac{1}{\sin\beta} = \frac{1}{\sin 45} = \underline{\underline{1.414}}$$

NOVO

$h = 6{,}62 \cdot 10^{-34}\ Js$

3. Pravokotno na gladino jezera posvetimo s curkom enobarvne svetlobe (λ= 500 nm) z gostoto energijskega toka 2 kW/m^2. Koliko fotonov te svetlobe se absorbira v 10 minutah v cm^3 vode 10 m pod gladino jezera ? Absorpcijski koeficient vode za svetlobo valovne dolžine 500 nm je 0,032 m^{-1}.

$z_1 = 10\ m$

$\lambda = 500\ nm$

$j_0 = 2\ kW/m^2$

$t = 600\ s$

$V_1 = 1\ cm^3 = 10^{-6}\ m^3$

$\mu = 0{,}032\ m^{-1}$

$$j = \frac{dP}{S\,dt} = \frac{w\,dV}{S\,dt} = \frac{w\,S\,dx}{S\,dt} = w\,c$$

$$dj = -j\,\mu\,dz$$

$$dw_{ab} \cdot c = -j\,\mu \cdot c\,dt$$

$$\Downarrow$$

$$-dw_{ab} = j\,\mu\,dt$$

$$\Downarrow$$

$$-w_{ab} = j_0\,e^{-\mu z} \cdot \mu \cdot t$$

$$dj = -j \cdot \mu \cdot dz \Rightarrow j = j_0\,e^{-\mu z}$$

$$c = \nu\lambda$$

$$W_{ab} = |w_{ab}| \cdot V_1 = j_0\,e^{-\mu z_1} \cdot t \cdot V_1 \cdot \mu$$

$$n = \frac{j_1 \cdot t \cdot V_1 \cdot \mu \cdot \lambda}{h \cdot c}$$

$$n = W_{ab}/h\nu = \frac{j_0 \cdot t \cdot V_1 \cdot e^{-\mu z_1} \cdot \lambda \cdot \mu}{h \cdot c} =$$

$$= \frac{2 \cdot 10^3 \cdot 6 \cdot 10^2 \cdot 10^{-6} \cdot 5 \cdot 10^2 \cdot 10^{-9} \cdot 0.72615 \cdot 0.032}{6{,}62 \cdot 10^{-34} \cdot 3 \cdot 10^8}$$

$$n = 7{,}02 \cdot 10^{16}$$

približno:

$j_1 = j_0\,e^{-\mu z} = 1{,}45\ kW/m^2$

$10^{-2}\ m$

$dj = \mu\,dx\,j_1 = 4{,}65 \cdot 10^{-5}\ W/cm^2$

$dj \cdot t = 2{,}79 \cdot 10^{-2}\ J/cm^2$

$S \cdot dj \cdot t = Q = 2{,}79 \cdot 10^{-2}\ J$

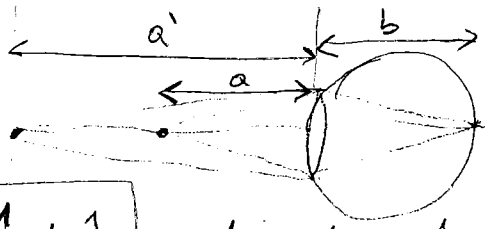
$$N = \frac{S \cdot dj \cdot t \cdot \lambda}{hc} = \frac{S\,\mu\,dx\,j_1\,t\,\lambda}{hc}$$

$$N = \frac{Q \cdot \lambda}{hc} = \frac{2{,}79 \cdot 10^{-2} \cdot 5 \cdot 10^{-7}}{6{,}62 \cdot 10^{-34} \cdot 3 \cdot 10^8} =$$

$$= 0{,}702 \cdot 10^{17} = 7{,}02 \cdot 10^{16}$$

② Daljnovidno oko ne vidi dobro predmetov, ki so oddaljeni od očesa manj kot 75 cm. Ocenite goriščno razdaljo leče za očala, ki jih to oko potrebuje, da vidi jasno tudi do razdalje 25 cm ?

Odg : $1/f = 2.7\ m^{-1}$



$a = 25\ cm$

$a' = 75\ cm$

Če $a = 25\ cm$ slika pade na mrežnico s pomočjo očal (f')

$$\boxed{\frac{1}{f'} = \frac{1}{f_{oko}} + \frac{1}{f_{OČALA}} = \frac{1}{a} + \frac{1}{b}} = \frac{1}{a} + \frac{1}{f_{oko}} - \frac{1}{a'} \Longrightarrow \frac{1}{f_{OČAL}} = \frac{1}{a} - \frac{1}{a'}$$

BREZ OČAL $\left\{ \boxed{\frac{1}{f_{oko}} = \frac{1}{a'} + \frac{1}{b}} \right. \Rightarrow \boxed{\frac{1}{b} = \frac{1}{f_{oko}} - \frac{1}{a'}}$

$$\frac{1}{f_{OČAL}} = \frac{1}{a} - \frac{1}{a'} = \left(4 - \frac{4}{3}\right)\frac{1}{m} = \frac{12-4}{3\ m}$$

$$= \frac{8}{3\ m} = 2{,}7\ m^{-1}$$

$$\frac{1}{b} = \frac{1}{f_{oko}} - \frac{1}{a'}$$

$$a' = 75\ cm = \frac{3 \cdot 100}{4}\ cm = \frac{3}{4}\ m$$

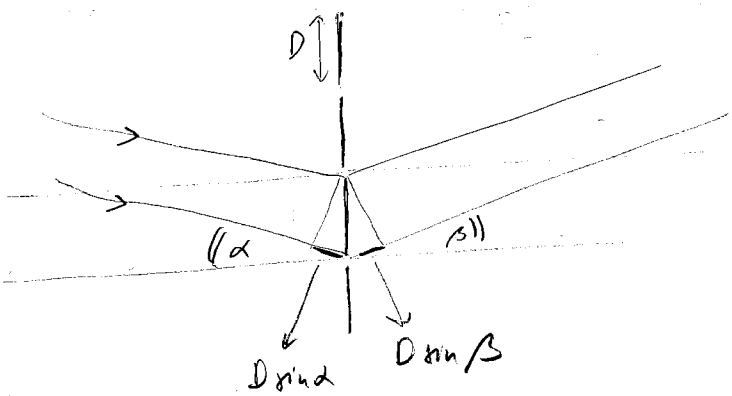
$$a = 25\ cm = \frac{100}{4}\ cm = \frac{1}{4}\ m$$

$$f_{OČAL} = \frac{1}{2.7}\ m = 0.37\ m$$

Vzporeden snop enobarvne svetlobe valovne dolžine 500 nm pada pod kotom 45° na uklonsko mrežico. Najmanj kolikšna sme biti razdalja med režami, da na drugi strani mrežice se lahko zaznamo prvi uklonski minimum ?

$\lambda = 500$ nm

$\alpha = 45°$



min. $$\boxed{D \cdot (\sin\alpha + \sin\beta) = (2N+1)\frac{\lambda}{2}}, \quad N = 0, 1, 2 \ldots$$

Č $\beta_0 = 90$: $\quad D_{min} = \dfrac{\lambda}{2 \cdot (\sin\alpha + 1)} = \underline{146{,}4 \text{ nm}}$

$N = 0$

4. Valovna dolžina rdeče svetlobe iz helij-neonskega laserja je 633 nm v zraku, v tekočini med roženico in lečo očesa pa 474 nm . Izračunajte lomni količnik in hitrost svetlobe v tej tekočini !

$\lambda_0 = 633$ nm (zrak)

$\lambda_1 = 474$ nm (tekočina)

$$\boxed{c_1 = \frac{c_0}{n}}$$

$$\boxed{\lambda_1 = \frac{\lambda_0}{n}}$$

$$n = \frac{\lambda_0}{\lambda_1} = 1.335$$

$$c_1 = \frac{3 \cdot 10^8 \frac{m}{s}}{1.335} = 2.25 \cdot 10^8 \frac{m}{s}$$

$0.75 c_0$

nal. Šipa je sestavljena iz dveh plasti. Prva plast je debela $x_1 = 2\,mm$, njena razpolovna debelina je $d_1 = 5\,cm$. Debelina druge plasti je $x_2 = 1{,}5\,mm$, njena razpolovna debelina je $d_2 = 3\,cm$. Koliki del upadne svetlobe se absorbira v šipi?

$$P = P_0 e^{-\mu_1 x_1 - \mu_2 x_2}$$

$$\frac{P}{P_0} = e^{-\mu_1 x_1 - \mu_2 x_2} = e^{-\frac{\ln 2}{x_{1/2}} x_1 - \frac{\ln 2}{x_{1/2}} x_2}$$

$$\frac{1}{2} = e^{-\mu x_{1/2}} \qquad \cancel{\ln 2 = \frac{1}{x_{1/2}\mu}} \qquad \ln 2 = \mu x_{1/2}$$

$$\mu = \frac{\ln 2}{x_{1/2}}$$

$$\frac{P}{P_0} = e^{-\ln 2\left(\frac{2\,mm}{50\,mm} + \frac{1{,}5\,mm}{30\,mm}\right)} = e^{-\ln 2\left(\frac{1}{25} + \frac{1}{20}\right)} =$$

$$= e^{-\frac{\ln 2}{500}\cdot 45} = e^{-\frac{\ln 2 \cdot 9}{100}} = 1 - \frac{\ln 2 \cdot 9}{100} =$$

$$= 1 - \frac{0{,}63}{100} = 1 -$$

$$A = 1 - \frac{P}{P_0} = \frac{0{,}63}{100} = \underline{\underline{6{,}3 \cdot 10^{-3}}}$$