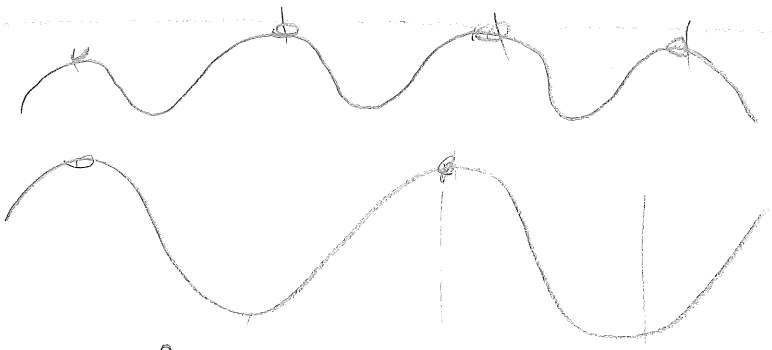
HÄFTESUPPGIFTER

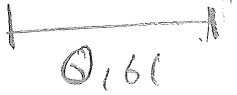
1.1 Mer energi $E = hf = \frac{hc}{\lambda}$ $\Rightarrow$ låg $\lambda \rightarrow$ hög E

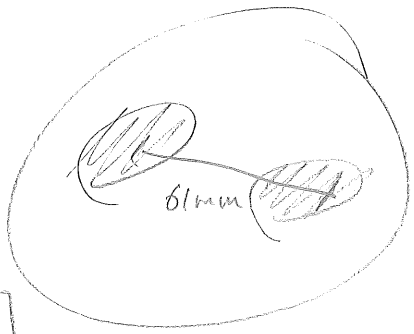
Absorberas lättare

1.2



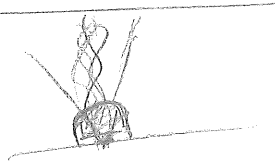
$\rho(x) = |\Psi(x)|^2$





$$f = \frac{c}{\lambda} = \frac{3 \cdot 10^8}{1{,}21} = \boxed{2{,}48 \cdot 10^8 \text{ Hz}}$$

2.1

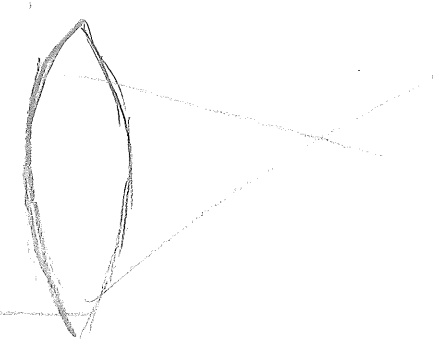


Ljuset fokuseras genom droppen

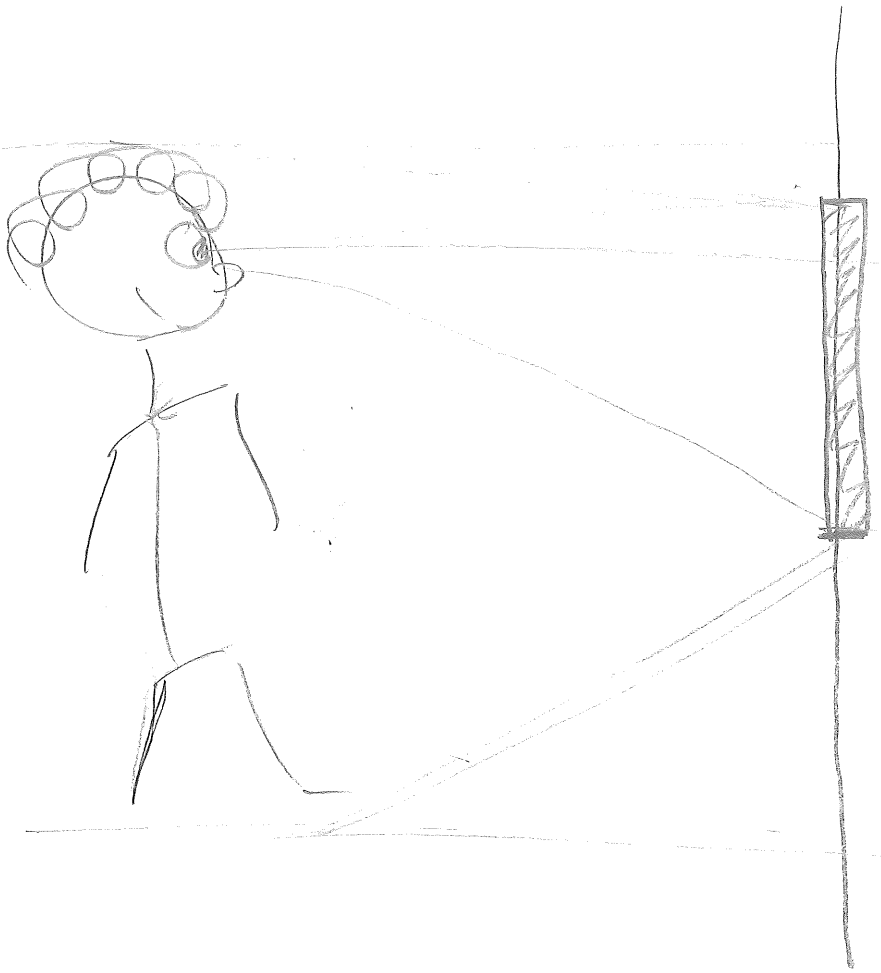
2.2 sprider $n_{luft} < n_{plexiglas}$ $\quad n_2 > n_1$

2.3

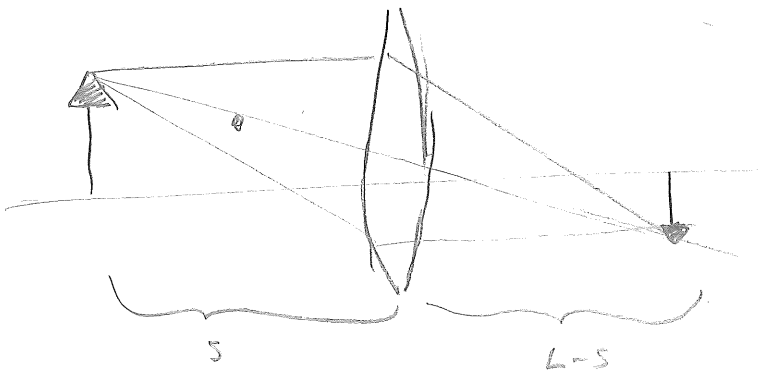
Minimum optisk väg.



2.4



2.5



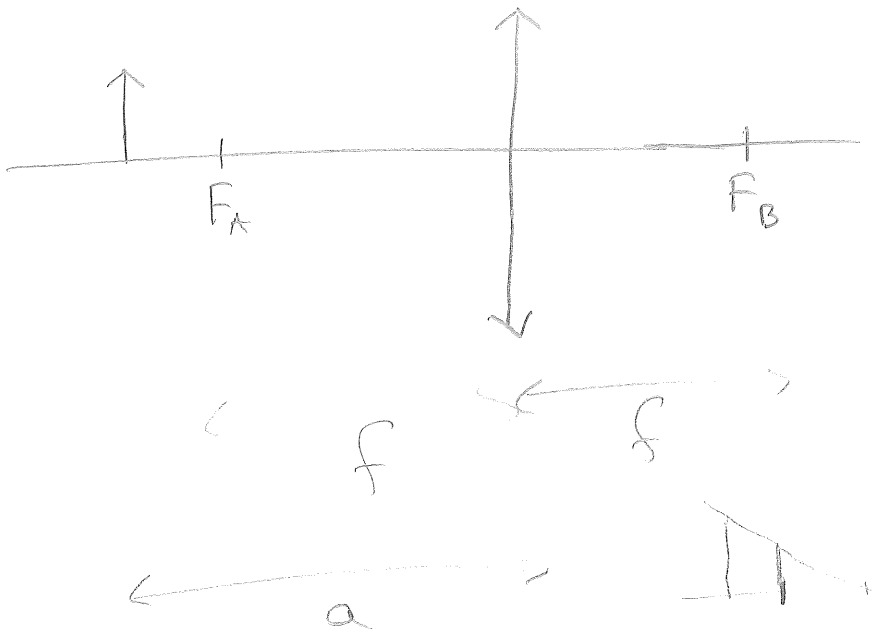
$$\frac{1}{s} + \frac{1}{L-s} = \frac{1}{f}$$

$$\frac{L-s+s}{(L-s)s} = \frac{1}{f} \Rightarrow f = \frac{Ls - s^2}{L}$$

$$s^2 - Ls + Lf = 0$$

$$s = \frac{L}{2} \pm \sqrt{\frac{L^2}{4} - fL}$$

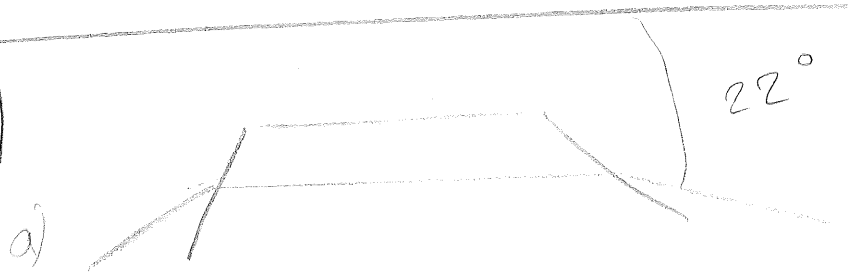
2.6



a) $a > 2f$, b) $0 < a < f$

c) $a = 2f$

2.7



a)

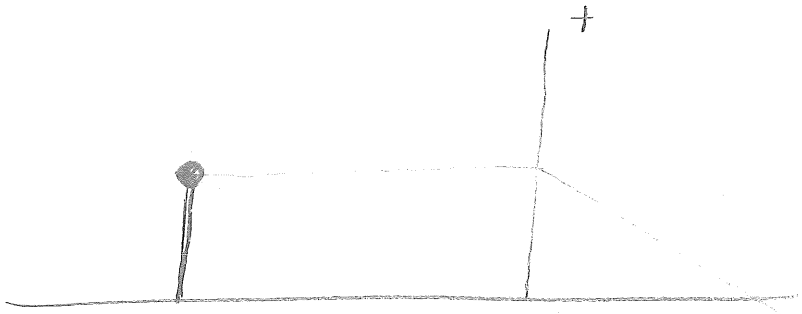
b) Svar: 46°

$\delta =$

3.1 Skillnaden i brytningsindex minskar, → brytningen minskar → vinkelförstoringen minskar.

3.2 Nej, vi vill även ha hög dispersion.

3.3



Bilden är upp-och ner → positiv lins

3.4 a) $L = \frac{1}{2}(f_1 + f_2)$, $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{L}{f_1 f_2}$

$$M = \frac{25}{f[cm]}$$

b)

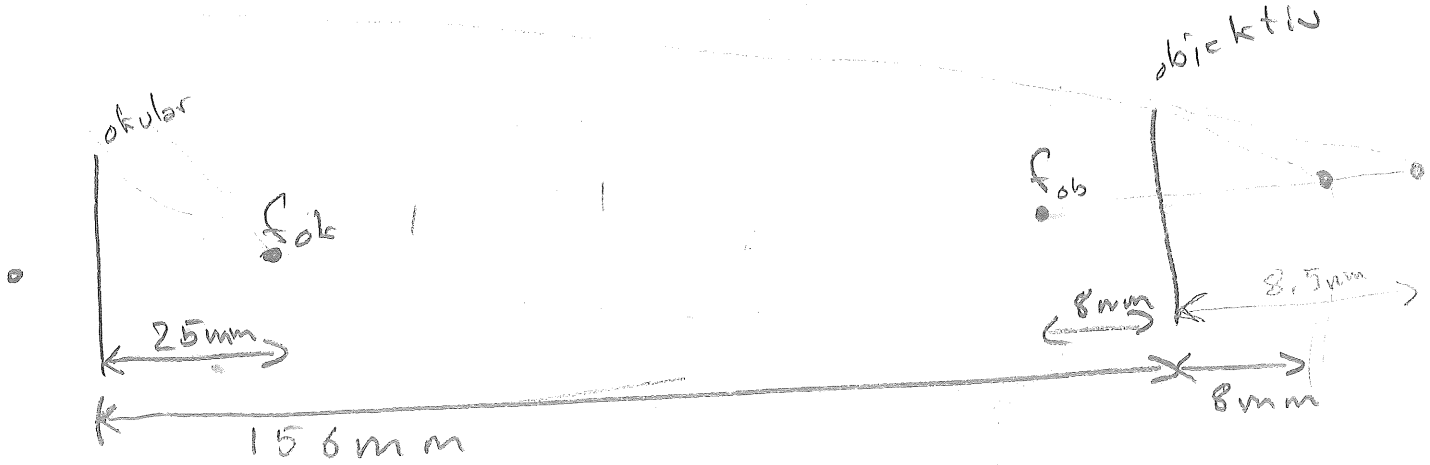
3.5

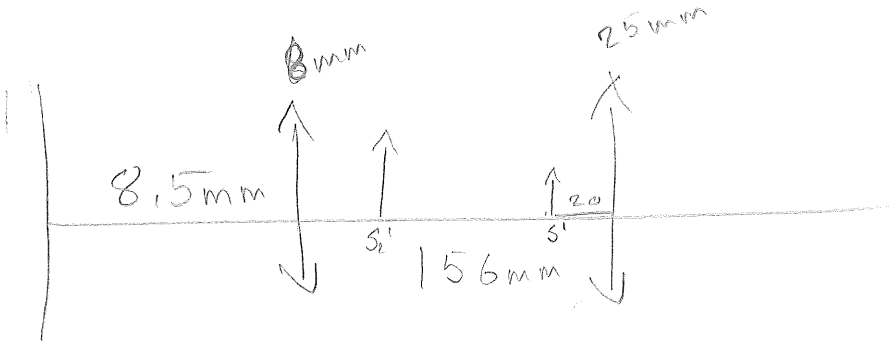
Objektivlins: $f_{ob} = 8.00\,mm$

$d_{ob} = 9,80\,mm$

Okularlins: $f_{ok} = 25,0\,mm$

$d_{ok} = ?$



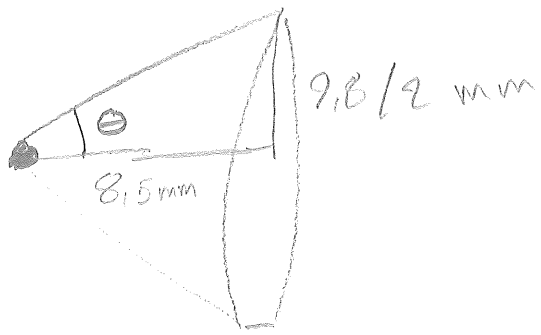


$$\frac{1}{8} = \frac{1}{8,5} + \frac{1}{s'} \Rightarrow s' = 136\,mm$$

$$\frac{1}{25} = \frac{1}{20} + \frac{1}{s_2'} \Rightarrow s_2' = -100$$

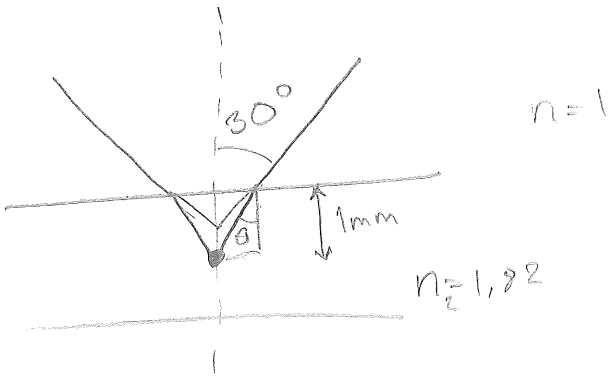
a) $m_1 = \frac{s'}{s} = 16 \quad m_2 = \frac{s_2'}{s'} = 5 \Rightarrow \boxed{m_1 \cdot m_2 = -80}$

b)



$$\theta = \arctan\left(\frac{9{,}812}{8{,}5}\right) = 30°$$

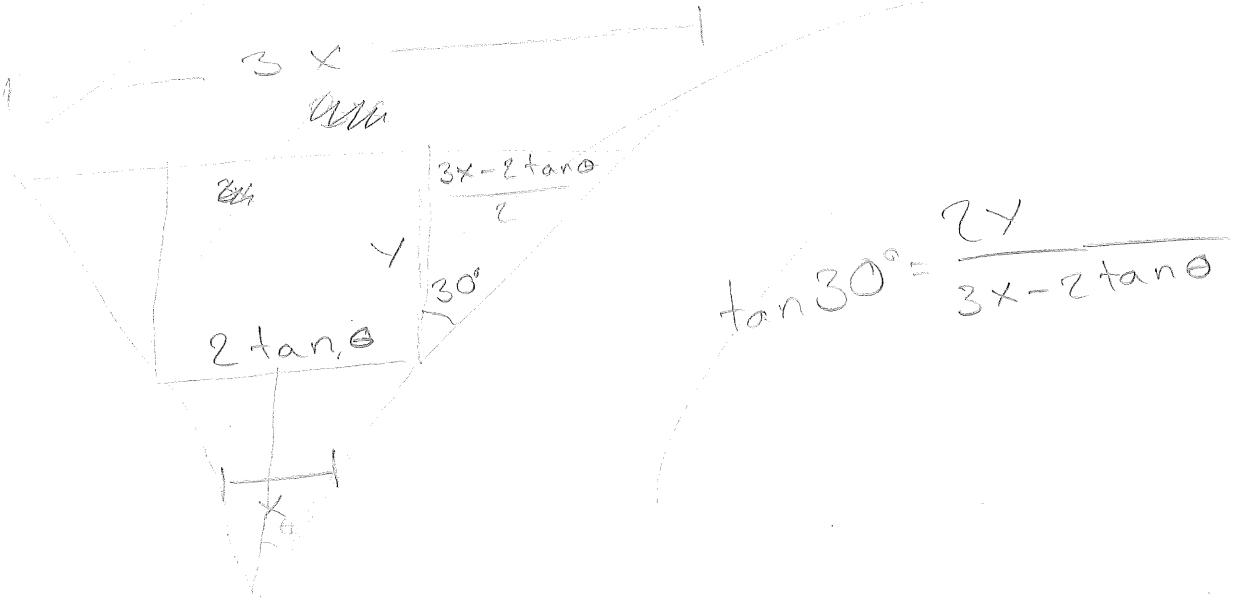
c)



$$\sin 30° = n_2 \sin\theta$$

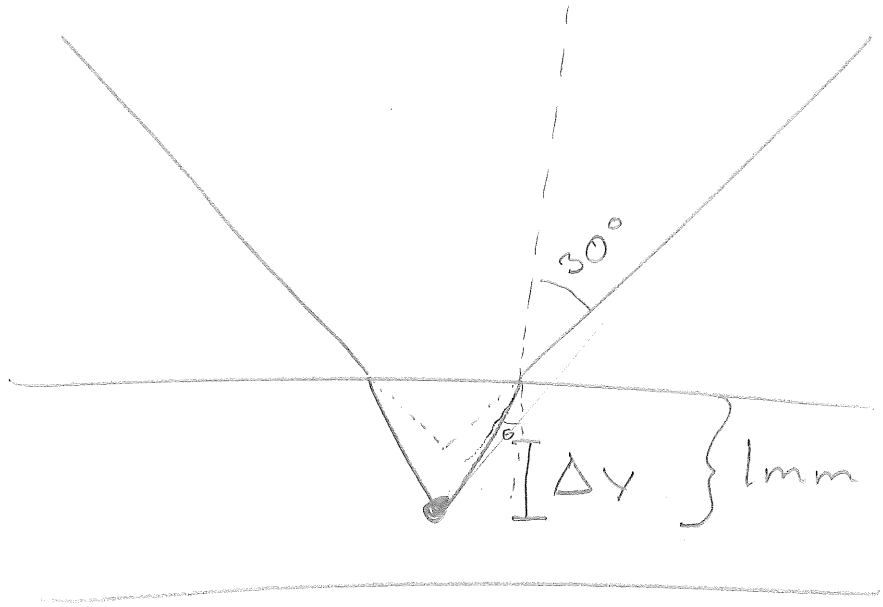
$$\tan\theta = \frac{x}{1}$$

$$\Rightarrow \theta = \arcsin$$



$$\tan 30° = \frac{2Y}{3x - 2\tan\theta}$$

c)



$\sin 30° = 1,82 \cdot \sin\theta$

$s' = \left(\frac{n_2}{n_1}\right) s = \frac{1}{1,82} \cdot 1,00 = \boxed{0,54\,mm}$

$\Delta y = 1 - 0,547 = \underline{0,45\,mm}$

Ursprungliga avståndet = 8,5

$8,5 + 0,46 = \boxed{8,95\,mm}$

d) $\boxed{\theta = 15,9°}$

e) Nu går strålarna rakt igen => 8,5 mm.

f) $\sin^2\left(\frac{15,9°}{2}\right) \cdot k = \sin^2\left(\frac{30°}{2}\right)$

$\boxed{k = 3,5}$

4.1

Om man knuffar horisontellt en gång per period så är läge B bäst eftersom det är då gungans hastighet är horisontell.

4.2

$$s_1 = 4\sin(2\pi(0{,}2x - 3t))$$

$$s_2 = \frac{5}{2}\sin(7x + 3{,}5t)$$

$s_1 = 4\sin(0{,}4\pi x - 6\pi t)$

a) $f = \frac{1}{T}$ $\quad \omega = 2\pi \cdot f$

$\omega = -6\pi$ (*)

$$\rightarrow f = \frac{\omega}{2\pi} = \frac{-6\pi}{2\pi} = \boxed{3\,Hz}$$

frekvensen för

— " —

$$s_1 = 3\,Hz$$

$$s_2 = \frac{3{,}5}{2\pi}\,Hz$$

b) $k = \frac{2\pi}{\lambda} \Rightarrow \lambda = \frac{2\pi}{k}$

s_1: $\lambda = \frac{2\pi}{0{,}4\pi} = \boxed{5\,m}$

s_2: $\boxed{\lambda = \frac{2\pi}{7}}$

c) Perioden

$T = \frac{1}{f}$ $\quad S_1: T = \frac{1}{3} \approx \boxed{0,33}$

$S_2: T = \frac{1}{3,5/2\pi} = \frac{2\pi}{3,5} \approx \boxed{1,8}$

d) $S_1: \boxed{A = 4}$ $\quad S_2: A = \frac{1}{2,5} = \boxed{0,4}$

e) $v = f\lambda$

$S_1: v = 3 \cdot 5 = \boxed{15}$

$S_2: v = \frac{3,5}{2\pi} \cdot \frac{2\pi}{7} \approx \boxed{0,5}$

f) S_1 rör sig åt höger.

S_2 —— " —— vänster.

4.3

$P = 1000\,W$

$A = 0{,}04\,m^2$

$f = 2{,}45 \cdot 10^9\,Hz$

$P = \frac{E}{t}$

$v = c = 3 \cdot 10^8$

a) $\lambda = \frac{c}{f} = \boxed{12\,cm}$

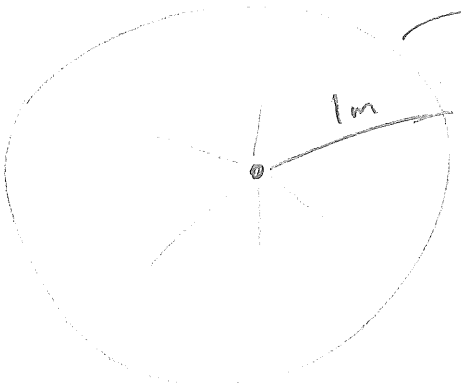
$T = \frac{1}{f} = \boxed{41\,ns}$

b) $E_e = \frac{P}{A} = \frac{1000}{0{,}04} = 400\,000\,W/m^2$

$$E_0 = \left(\frac{2E_e}{\varepsilon_0 c}\right)^{1/2} = \left(\frac{2 \cdot 400000}{\varepsilon_0 c}\right)^{1/2} =$$

4.4

a) P = 100W i 1m



Arean av ett klot = $4\pi r^2 = 4\pi$

$$I = \frac{P}{A} = \frac{100}{4\pi} = \boxed{7,96\ W/m^2}$$

b) $$E = \left(\frac{2I}{\varepsilon_0 c}\right)^{1/2} = \boxed{77,4}$$

$$B = \frac{E}{c} = \boxed{2,6 \cdot 10^{-7}}$$

4,5 $I = 1,40 \pm 0,06 \ \ w/m^2$

$$E_{max} = \left(\frac{2I}{\varepsilon c}\right)^{1/2} = 33,17$$

$$E_{min} = \left(\frac{2I}{\varepsilon c}\right)^{1/2} = 31,78$$

$\Rightarrow E = 32,5 \pm 0,7$

4,6 a) c) och d) eftersom de beror på x och ut, se s. 133.

4.7 $s = A\sin\left(2\pi\left(\frac{t}{T} \pm \frac{x}{\lambda}\right) + \alpha\right)$ $\quad \lambda = 3,4$

$x = 0 \Rightarrow s = A\sin\left(2\pi\frac{t}{T} + \alpha\right)$ $\quad A = 3$

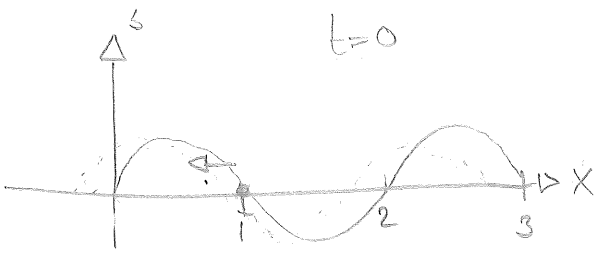
$\sin(\ ) = 0 \Rightarrow \alpha = -2\pi\frac{t}{T} = 0 + n\pi$, $\quad \alpha = 0\pi$

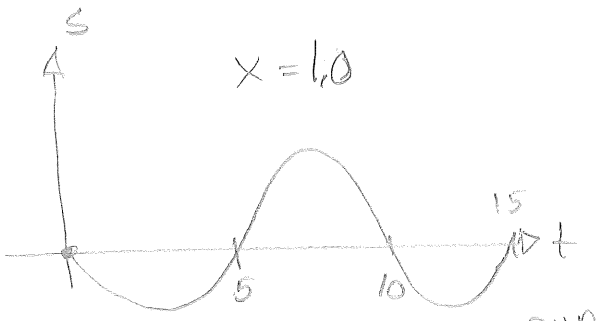
$t = 0 \Rightarrow$

$t = 5 \Rightarrow 3\sin\left(2\pi\left(\frac{5}{T}\right)\right) = 0$ $\quad T = 10$

4.8

$$s(x,t) = A\sin\left(2\pi\left(\frac{t}{T} \pm \frac{x}{\lambda}\right) + \alpha\right)$$





$\alpha = 0 \quad \lambda = 2 \quad , T = 10 \quad , A = A$

$$s(x,t) = A\sin\left[2\pi\left(\frac{t}{10} \pm \frac{x}{2}\right)\right]$$

Hitta samma punkt (x), gå lite fram i tiden på högra graf. Vänster

4.9

a)

$A = 0{,}15$
$\lambda = 6$
$T = 22$
$\alpha = 2$

$$s_t' = A \cdot 2\pi \cdot \frac{1}{T} \cos(\quad)$$

b) $$v = \lambda \cdot f = \lambda \cdot \frac{1}{T} = \frac{6}{22} = 0{,}27$$

$$\frac{ds}{dt} = \omega A = 2\pi f \cdot A = 2\pi \cdot \frac{1}{T} \cdot A = 0{,}043$$

4.10

$\lambda = 5$

$T = 2$

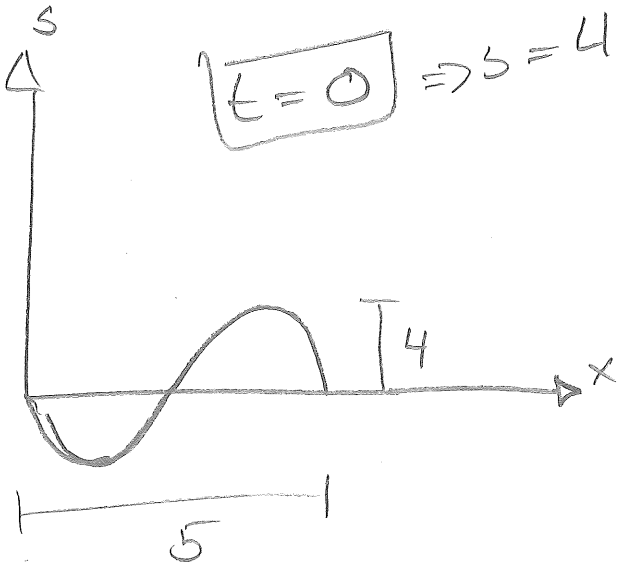
$\alpha = \pi$

$A = 4$

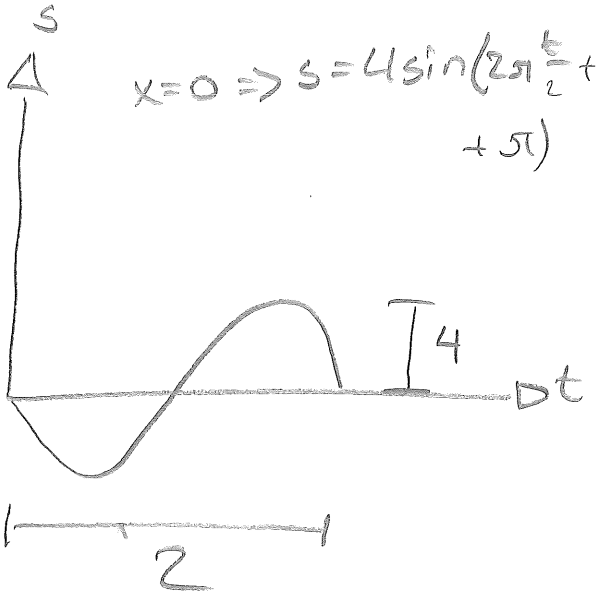
Vågen rör sig åt vänster, $-x$ riktn.

$$s = 4\sin\left(2\pi\left(\frac{t}{2} + \frac{x}{5}\right) + \pi\right)$$

$\boxed{t = 0} \Rightarrow s = 4\sin\left(2\pi \cdot \frac{x}{5} + \pi\right)$



$x = 0 \Rightarrow s = 4\sin\left(2\pi\frac{t}{2} + \pi\right)$



5.1 För att vågorna inte är i fas. Det sker därför lika mycket utsläckning som förstärkning.

5.2 Mikrofonen läser av den inkommande vågen och sedan sänds samma våg ut i hörlurarna fast fasförskjuten.

5.3 $f_1 = 440\,Hz$ $f_2 = 442\,Hz$

$f_2 - f_1 = \boxed{2\,Hz}$

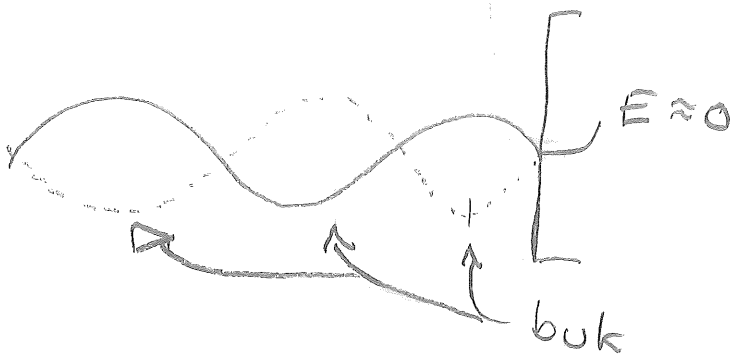
5.4

NÄSTA SIDA

5.5

$\lambda_0 = 589\,nm$

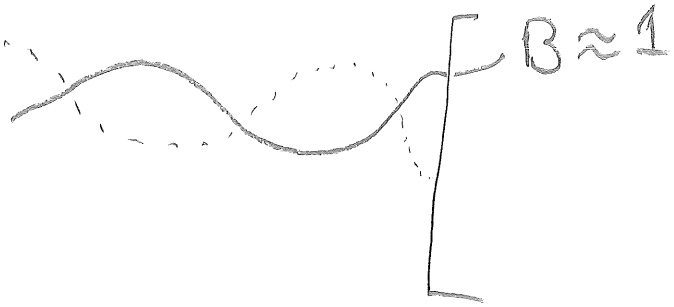
a) Tre svängningsbukar för E-fältet:



$\lambda/4\,,\ 3\lambda/4\,,\ 5\lambda/4$

b)

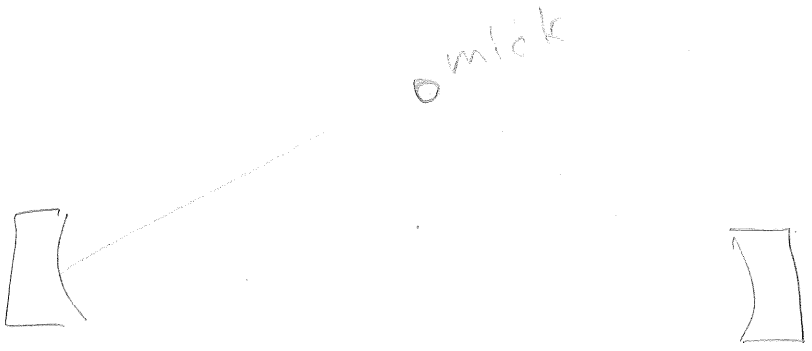
$0,\ \lambda/2\,,\ \lambda$



c) Där E-fältets noder är.

$\lambda/4,\ 3\lambda/4,\ 5\lambda/4$

5.4



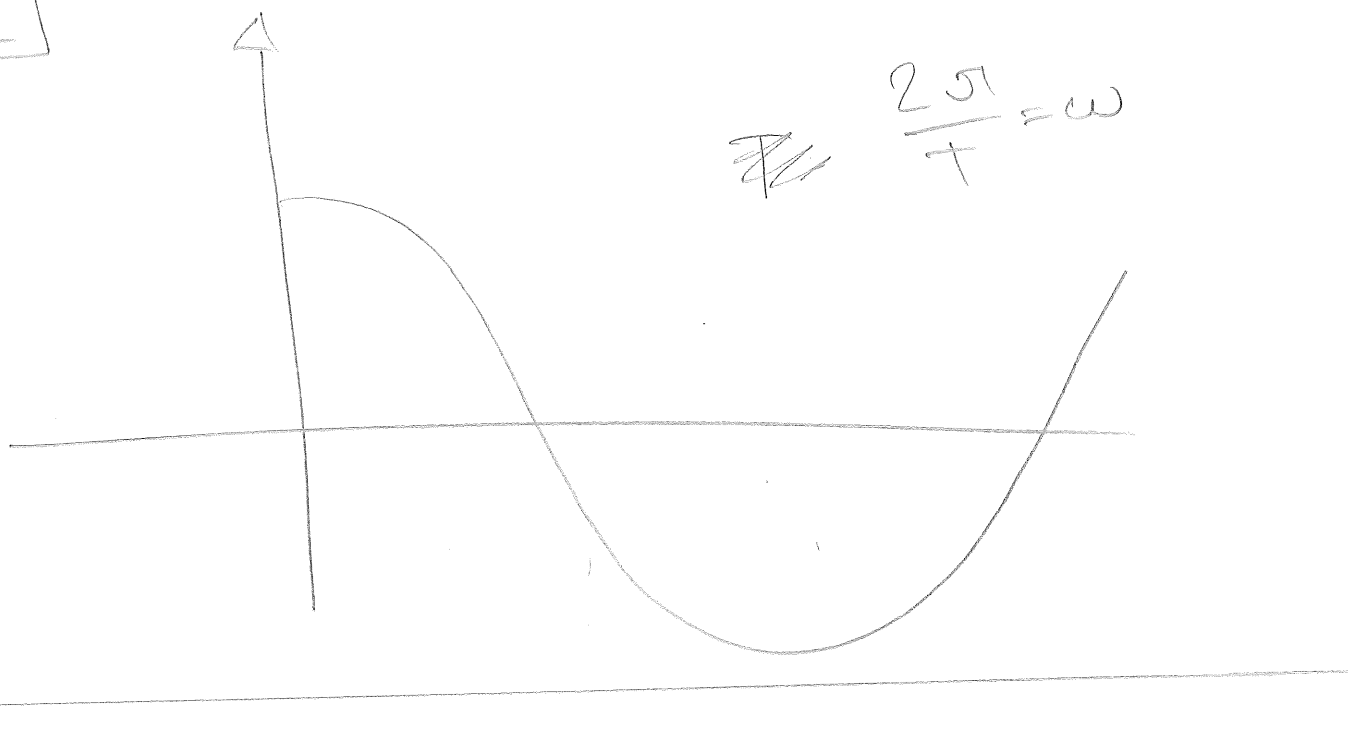
a) $I_{mick} = 4I_0$

Ljudnivå [dB]: $10 \lg\left(\frac{I}{I_0}\right)$ = Antal dB

Antal db = $10 \lg\left(\frac{4I_0}{I_0}\right)$ = 6,02 dB

b) Antal db = $10 \lg\left(\frac{2I_0}{I_0}\right) = 10 \lg 2$ = 3 dB

2



$\frac{2\pi}{T} = \omega$

KAPITEL 7

7.1 C och A

7.2

a) A $\underline{<}$ C

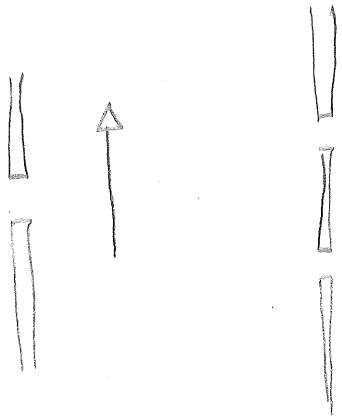
b) B $\underline{<}$ C

c) A $\underline{<}$ B

Glaset förskjuter 1,5 λ

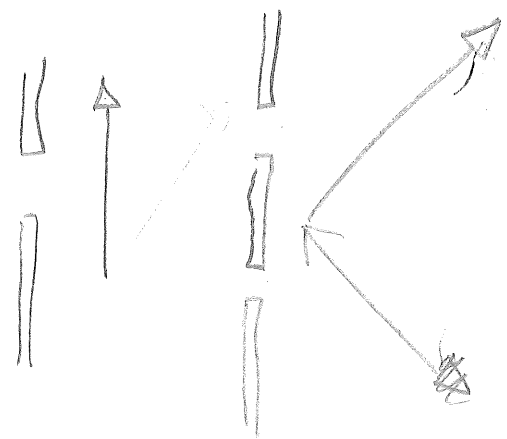
7.3

a)



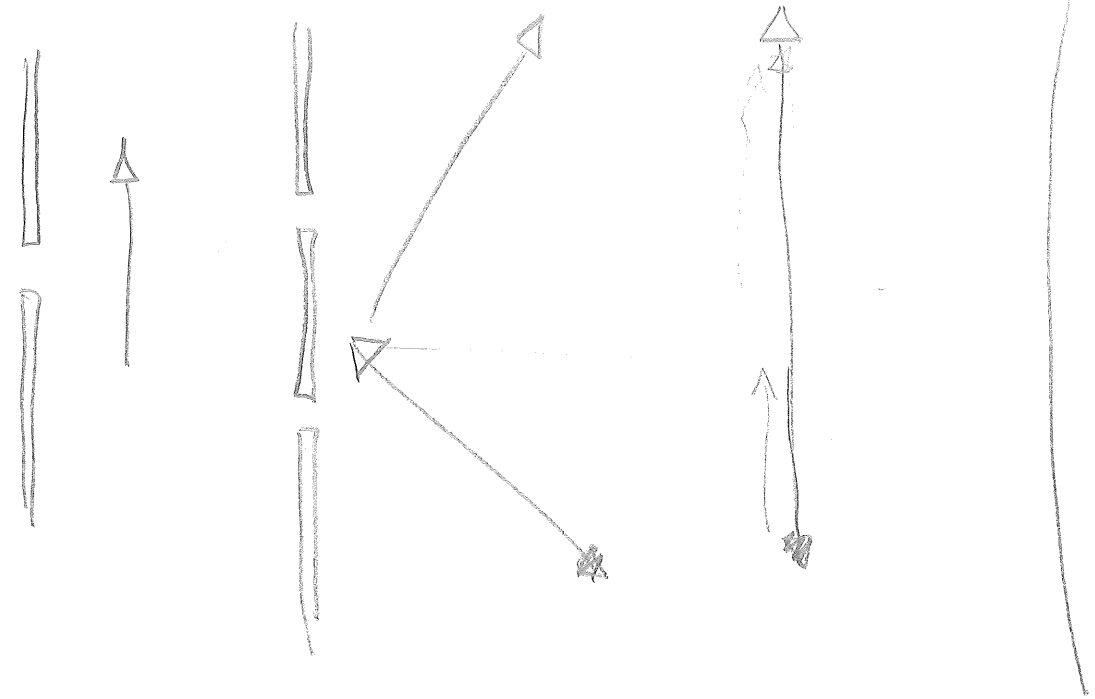
Allt ljus har samma kommer det sortf. interferera (Ikradant)

b)

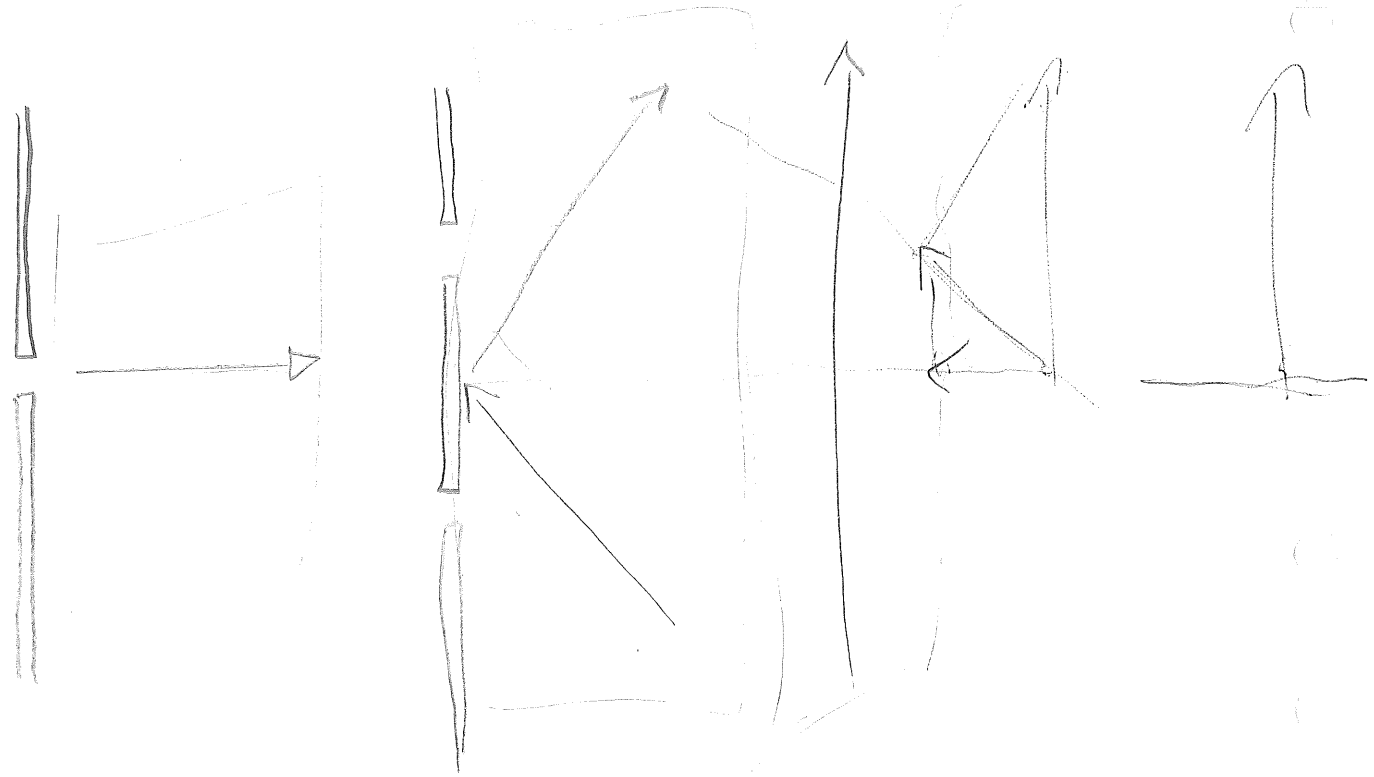


Ingen interferens.

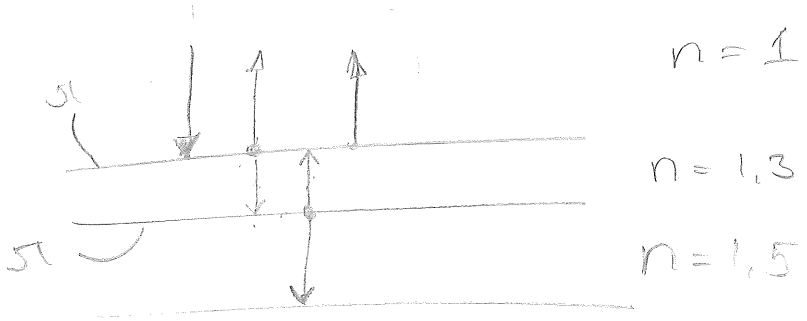
c)



d)



7.4



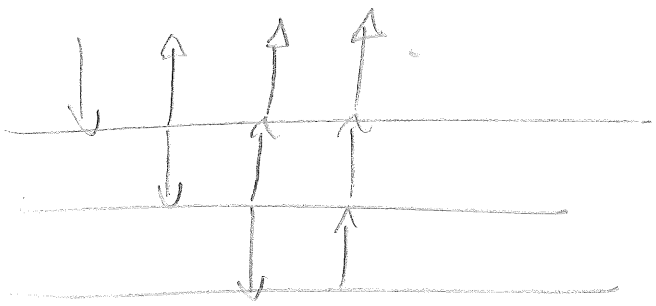
$$2 \cdot d \cdot 1{,}3 = \frac{\lambda}{2} + n \cdot \lambda = \lambda \left(\frac{1}{2} + n \right)$$

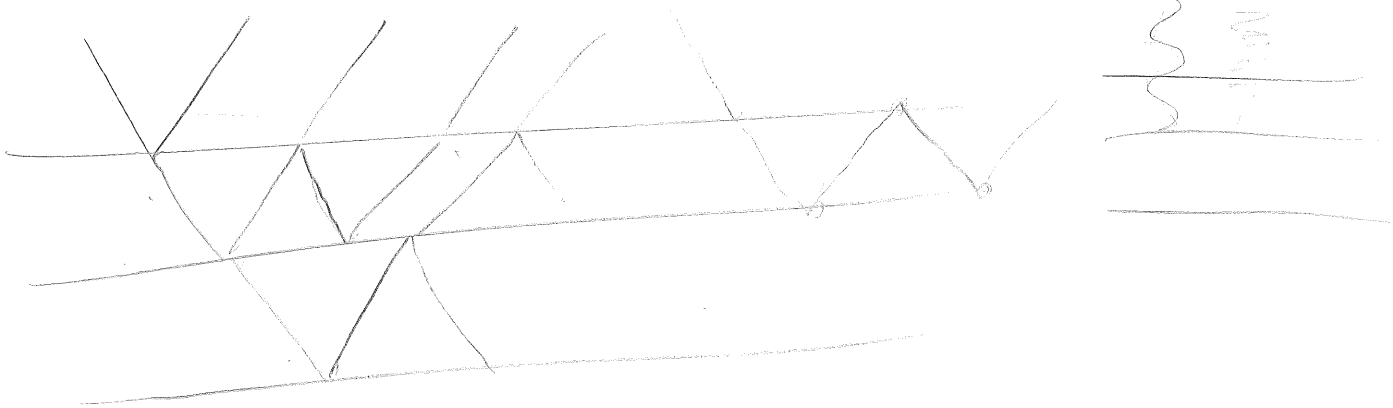
$$\begin{cases} 2d \cdot 1{,}3 = 525 \left(\frac{1}{2} + n \right) \\ 2d \cdot 1{,}3 = 675 \left(\frac{1}{2} + (n+1) \right) \end{cases}$$

$d = 0{,}21 \mu m$

7.5

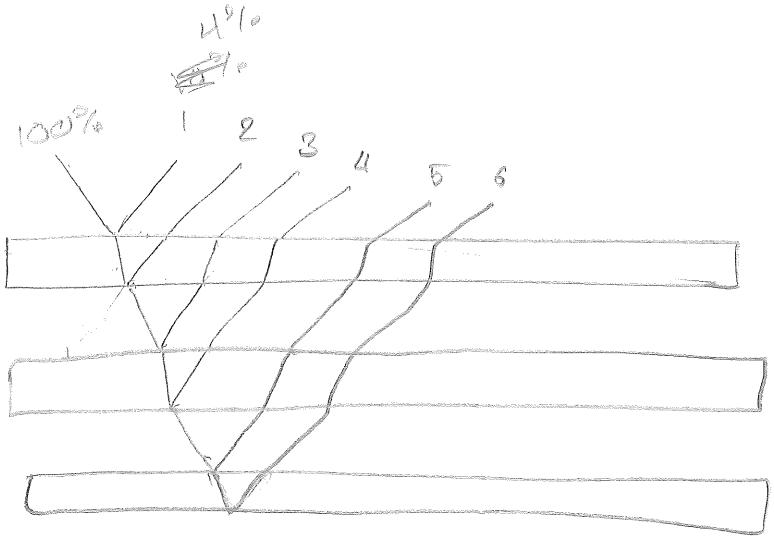
a)





7.5

a)



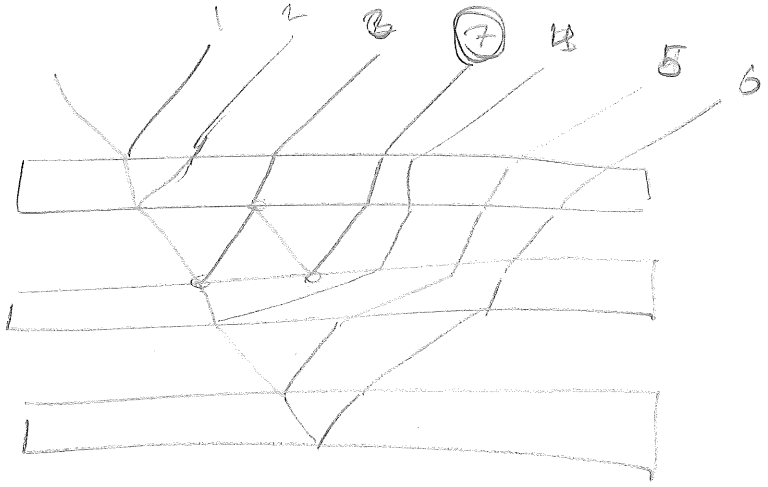
n = 1,5

Tre

b) Hur mkt är glasets reflektans? 4%

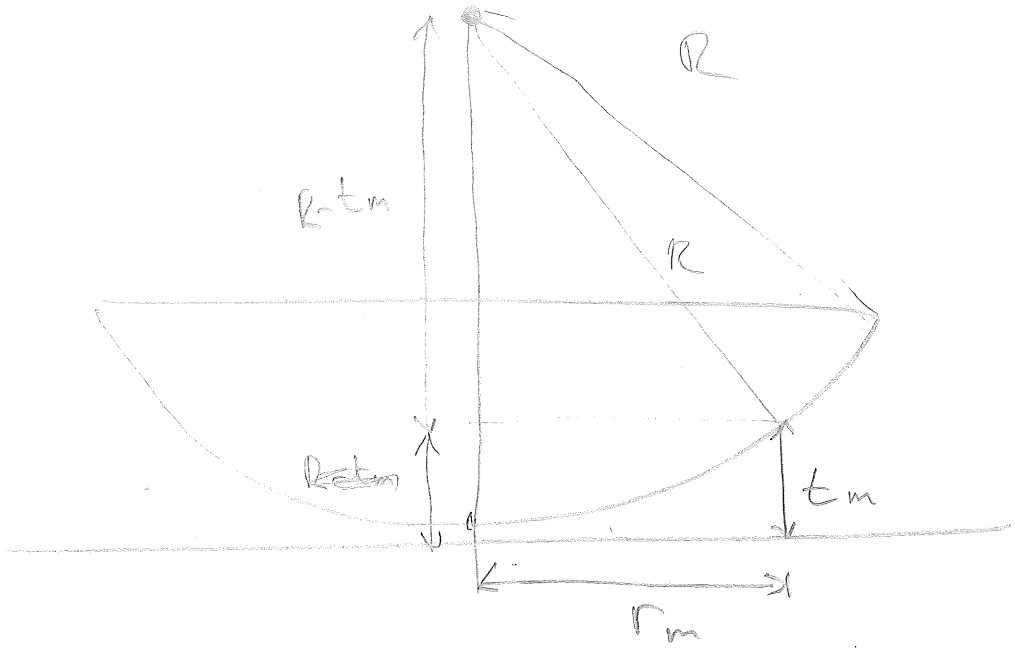
33% svagare

c)



En extra studs mellan glasen. Vilka glas?

7.6



$$R = \frac{r_m^2 + t_m^2}{2 t_m}$$

$$2 n_t t_m + \Delta r = m \lambda \quad \text{(bright)}$$

$$\Rightarrow t_m = \frac{m\lambda - \Delta r}{2 n_t} = 2\mu\text{m}$$

$\lambda = 633\text{nm}$

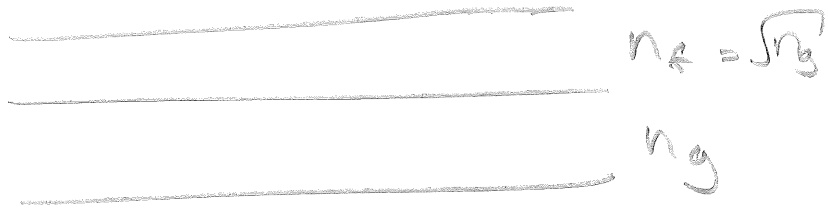
$m = 5^{\text{th}}$

$n_t = 1,0$

$\Delta r = 633/2$

$$\Rightarrow \boxed{R = 6,78\text{m}}$$

7.7

a) 

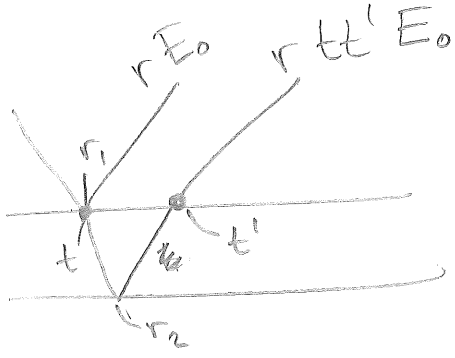
$$n_f = \sqrt{n_g} = \sqrt{1{,}54} = \boxed{1{,}24}$$

$$n_f \cdot d = \frac{\lambda_0}{4} = \frac{550\,nm}{4} = 112{,}5\,nm$$

$$\Rightarrow \boxed{d = 110\,nm}$$

b) $$r = \frac{n_1 - n_2}{n_1 + n_2} = \boxed{-0{,}055}$$

5% reflektans med fasskifte

c) 

Stokes relation

$$tt' = 1 - r^2$$

$$E_{tot} = r_1 E_0 - r_2(1 - r_1^2) E_0$$

enär fasförskjutning

Exo 4

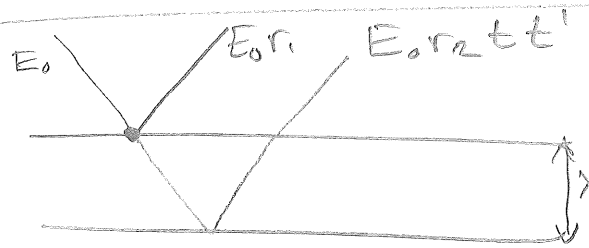
$$I_{tot} = E_0^2 \left(r_1 - r_2(1 - r_1^2)\right)^2 = I$$

$$r_1 = \frac{1 - 1{,}38}{1 + 1{,}38} = 0{,}16$$

$$r_2 = \frac{1{,}38 - 1{,}54}{1{,}38 + 1{,}54} = 0{,}05$$

$$R = \frac{I_{tot}}{I_0} = \boxed{0{,}11}$$

c)



1,0

$n = 2{,}1$

$n = 1{,}5$

$$E_{tot} = E_0 \left(r_1 + r_2(1 - r_1^2)\right)$$

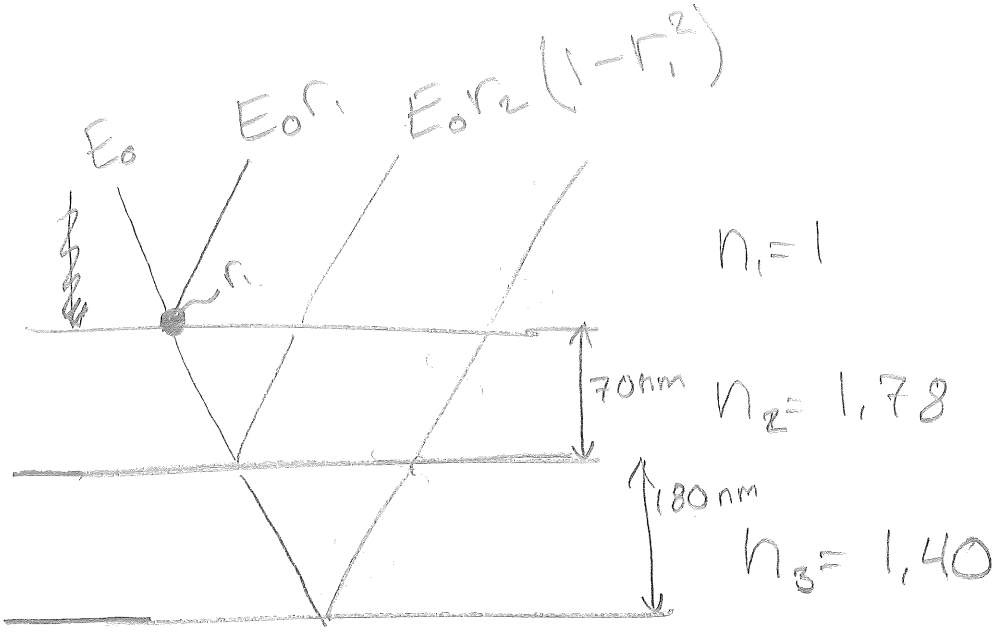
$$r_1 = \frac{1 - 2{,}1}{1 + 2{,}1} = 0{,}3548$$

$$I_{tot} = E_0^2 \, 0{,}24$$

$$r_2 = \frac{2{,}1 - 1{,}5}{2{,}1 + 1{,}5} = 0{,}17$$

$$\boxed{R = 0{,}25}$$

7.8

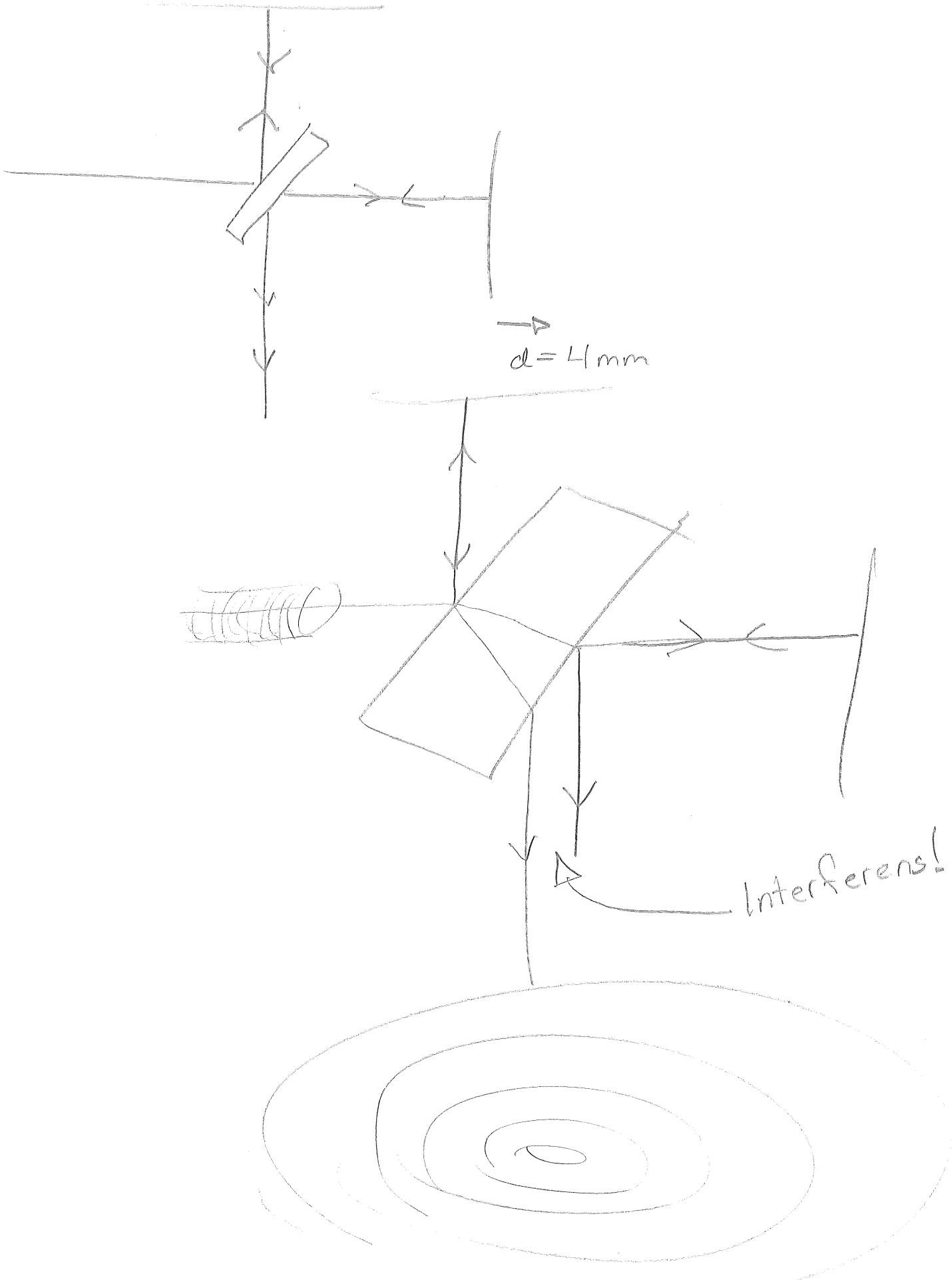


$$n_2 \cdot 2 \cdot 70 = \left(m + \frac{1}{2}\right)\lambda$$

$$\lambda = \frac{140 \cdot 1,78}{1/2} = \boxed{498,4\,nm}$$

8.1

$\lambda = 589\,nm$



8.1

a) $p\lambda = 2d(1-\cos\theta)$

$p = 1$, $\lambda = 589\,nm$, $d = 4\,mm$

$\Rightarrow \boxed{\theta = 0{,}7°}$

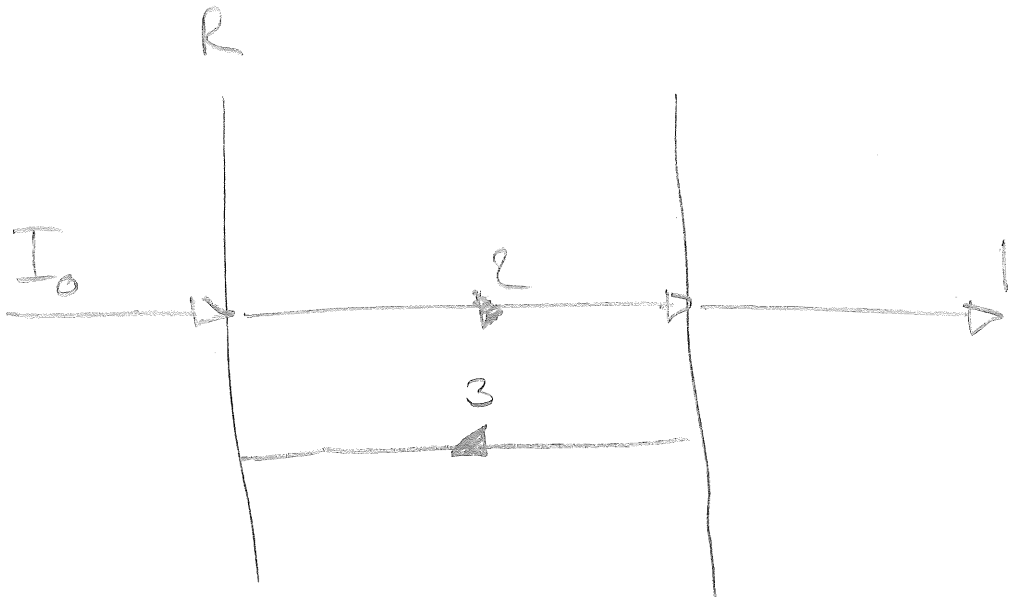
b) $\Delta m = \frac{2\Delta d}{\lambda}$

$\lambda = 589\,nm$ $\Delta m = 155$, $\Delta d = 100\,mm\,(n-1)$

$\boxed{n = 1{,}000456}$ om luft hade haft $n = 1{,}000000$.

8.4

$R = 0,95 \qquad \left(r = \sqrt{0,95} \right)$



1) $T = \dfrac{1}{1 + F \sin^2 \delta}$, $F = \dfrac{4R}{(1-R)^2}$

$T_{max} = I_0$, $I_{min} = 0,000657$

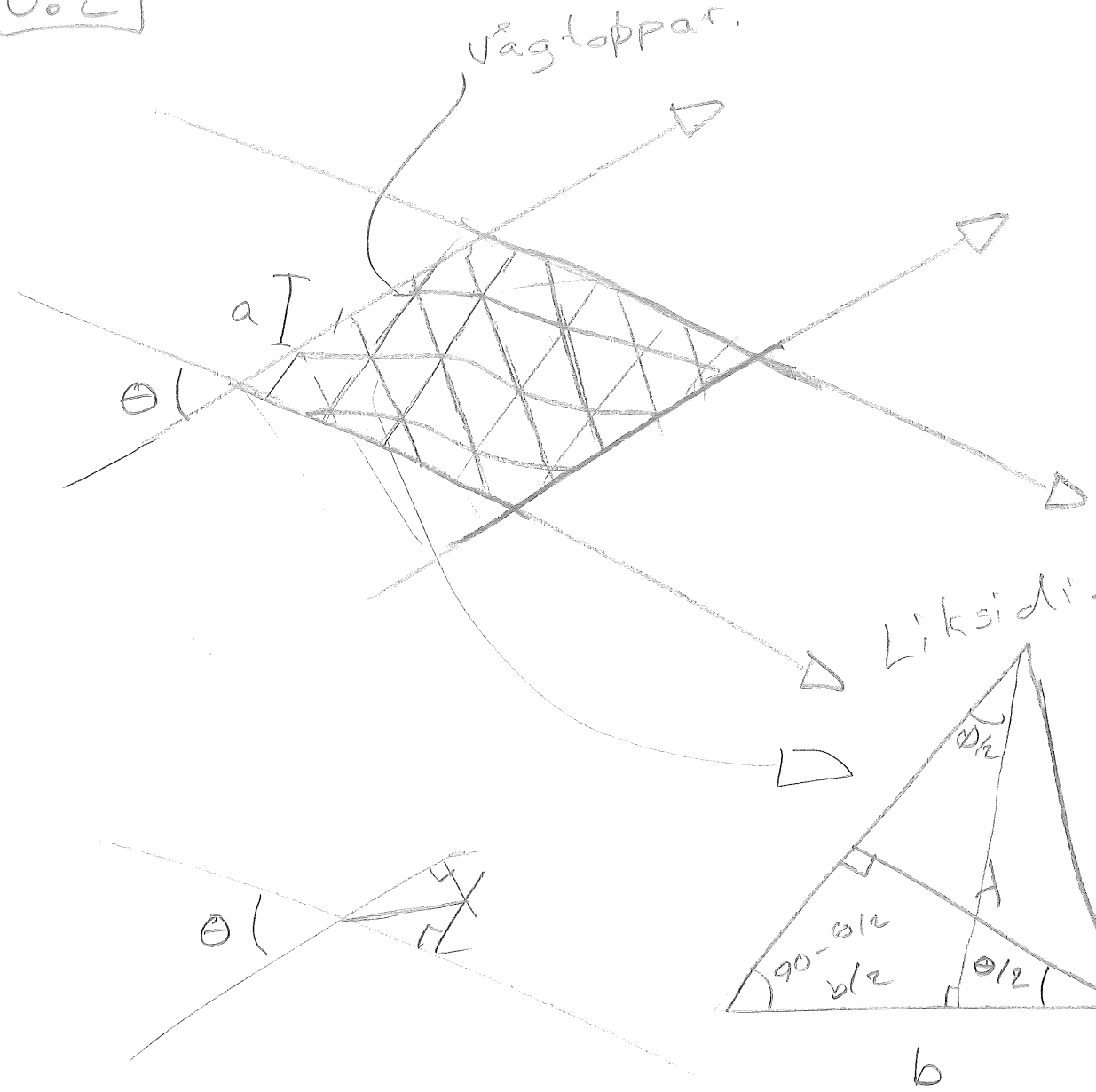
2) 1 är 5% av 2

$I = 20 I_0$, $I = 0,013$

3) $I = 20 I_0 - I_0 = 19 I_0$

$I = I_0 (0,013 - 0,000657) = \boxed{0,0125 I_0}$

8.2



$$\begin{cases} b = \dfrac{\lambda}{\cos(\theta/2)} \\ \tan(\theta/2) = \dfrac{b}{2a} \end{cases} \Rightarrow$$

$$2a\tan(\theta/2) = \frac{\lambda}{\cos(\theta/2)}$$

$$\boxed{a = \frac{\lambda}{2\sin(\theta/2)}}$$

8.3

$R = 0{,}93$

5 mm

5 - 7.8

$\lambda = 0{,}6\,\mu m$

Anti-reflex

a) ??

b) $F = \frac{\pi\sqrt{R}}{1-\sqrt{R}^2} = \boxed{43}$

$$\Delta\lambda_{min} = \frac{\lambda}{mF} = \frac{\lambda}{\frac{2\pi}{\lambda}F} = \frac{\lambda^2}{2\pi F} = \boxed{0{,}83\,pm}$$

c) $2d\cos\theta = m\lambda$

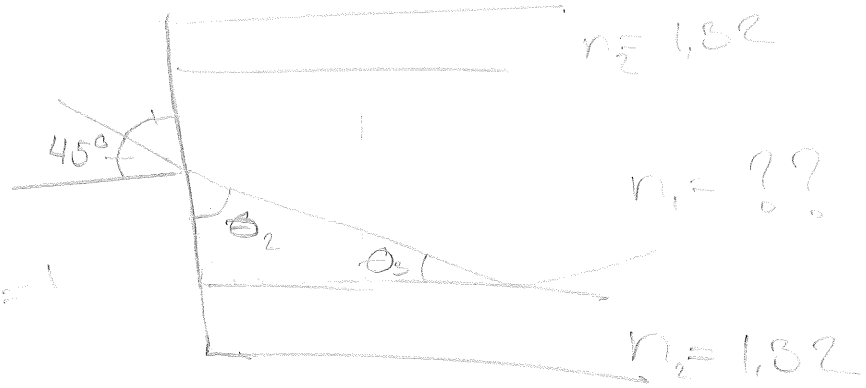
$\boxed{d \text{ ökar} \rightarrow \theta \text{ minskar.}}$

d) $\begin{cases} 2d_1\cos\theta = m\lambda \\ 2d_2\cos\theta = (m+1)\lambda \end{cases} \rightarrow d_2 = d_1 + \frac{\lambda}{2(\cos\theta)}$

$\cos\theta = 1$

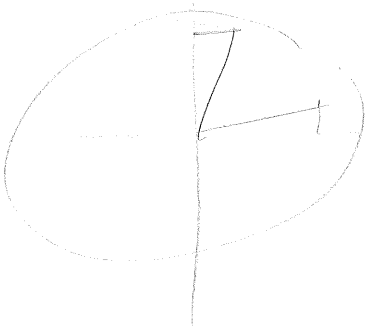
ökni $\frac{\lambda}{2} = \boxed{0{,}3\,\mu m}$

10.1



$$\sin\theta_1 = n_1 \sin\theta_2$$

$$\frac{1}{\sqrt{2}} = n_1 \sin\theta_2 \Rightarrow \theta_2 = \arcsin\left(\frac{1}{\sqrt{2}\, n_1}\right)$$



$$\theta_2 = 90 - \theta_2$$

$$n_1 \sin\theta_2 = 1{,}52$$

$$n_1 \sin(90 - \theta_2) = 1{,}52$$

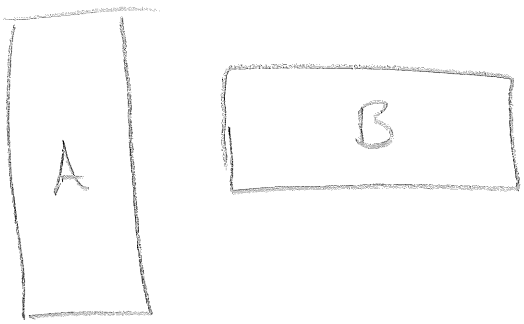
$$n_1 \cos(\theta_2) = 1{,}52$$

$$\boxed{n_0 \sin\theta_m = \sqrt{n_1^2 - n_2^2}}$$

$$\frac{1}{\sqrt{2}} = \sqrt{n_1^2 - 1{,}52^2}$$

$$\Rightarrow \quad \frac{1}{2} = n_1^2 - 1{,}52^2 \Rightarrow \boxed{n_1 = 1{,}497}$$

11.1

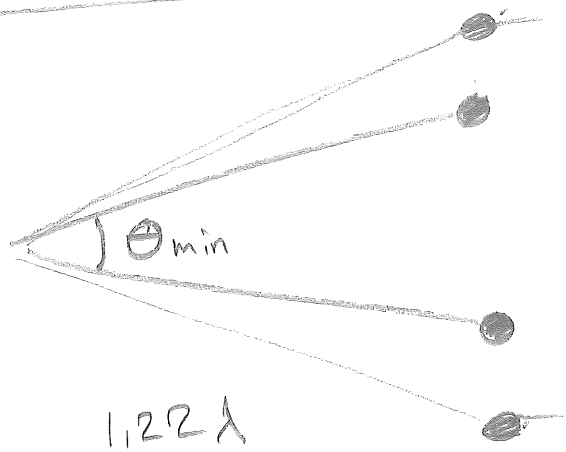


$b \sin\theta = m\lambda$

~~b~~ $\sin\theta$ ökas => b minskas

11.2 Baserna har längre våglängd => θ ökar.

11.3



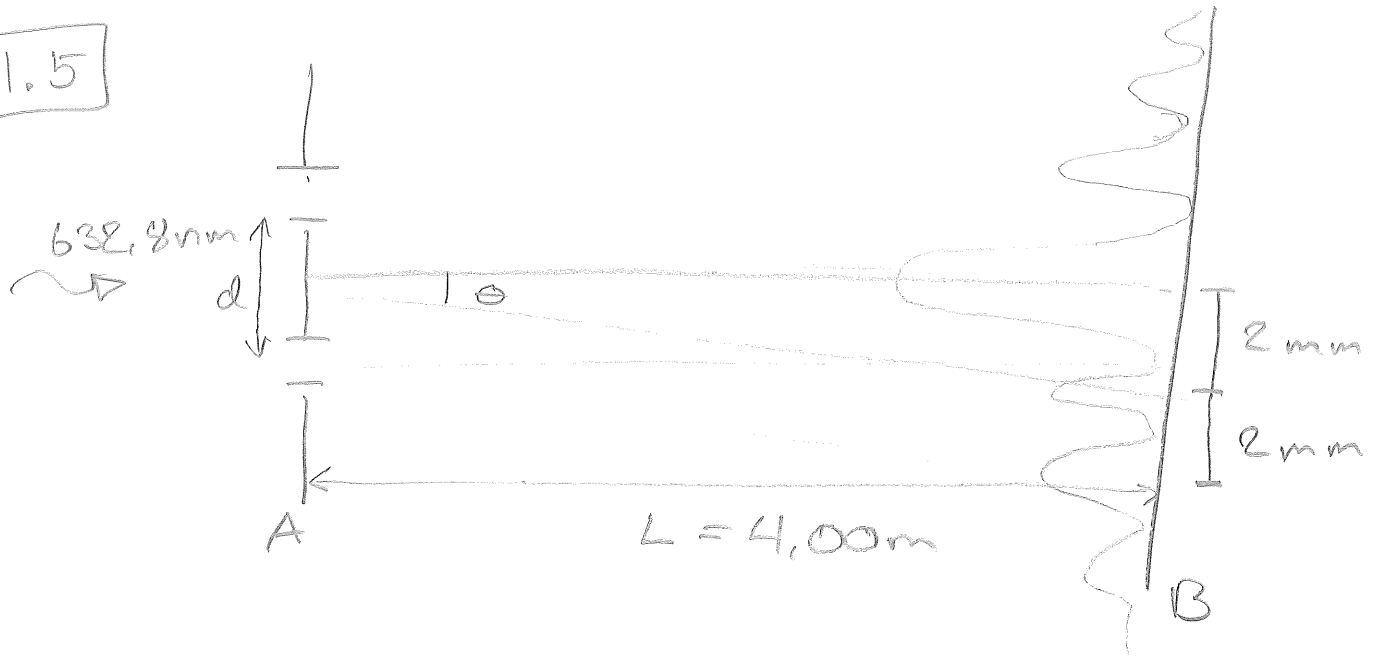
$$(\Delta\theta)_{min} = \frac{1{,}22\lambda}{D}$$

Vi vill öka $(\Delta\theta)_{min}$ => Minska D => Tända!

11.4 Inte interferens:
- en spalt.
- spalt för bred.

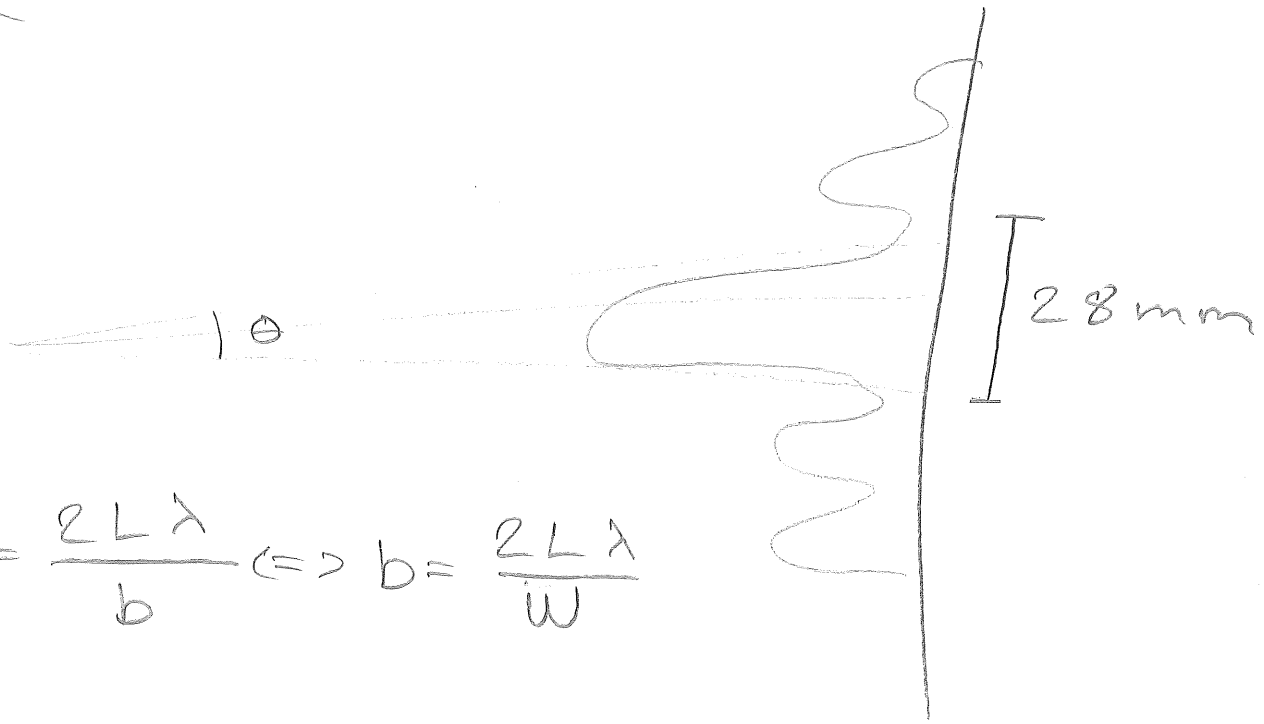
Måste vara Diffraktion!

11.5



a) $\begin{cases} \tan\theta = \dfrac{y}{D} \\ d\sin\theta = m\lambda \end{cases} \Rightarrow d = \dfrac{D m \lambda}{y} = \boxed{1,3\,mm}$

b)

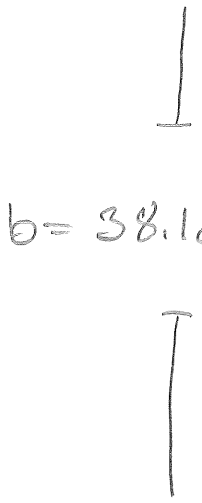


$$W = \frac{2L\lambda}{b} \Leftrightarrow b = \frac{2L\lambda}{W}$$

$\boxed{b = 0,18\,mm}$

11.6

a)



$b = 38.1\,cm$

$\Delta\theta_{1/2} = \frac{\pi}{2}$

$$\sin\theta_{1/2} = \frac{1{,}22\lambda}{D} = \frac{1{,}22\,v}{Df}$$

$$\Rightarrow f = \frac{1{,}22\,v}{D \cdot \sin(\Delta\theta_{1/2})} = \frac{1{,}22 \cdot 340}{38{,}1 \cdot 10^{-2} \cdot 1} = \boxed{1{,}09\,kHz}$$

b)

$$\lambda = \frac{v}{f} = \frac{340}{15 \cdot 10^3} =$$

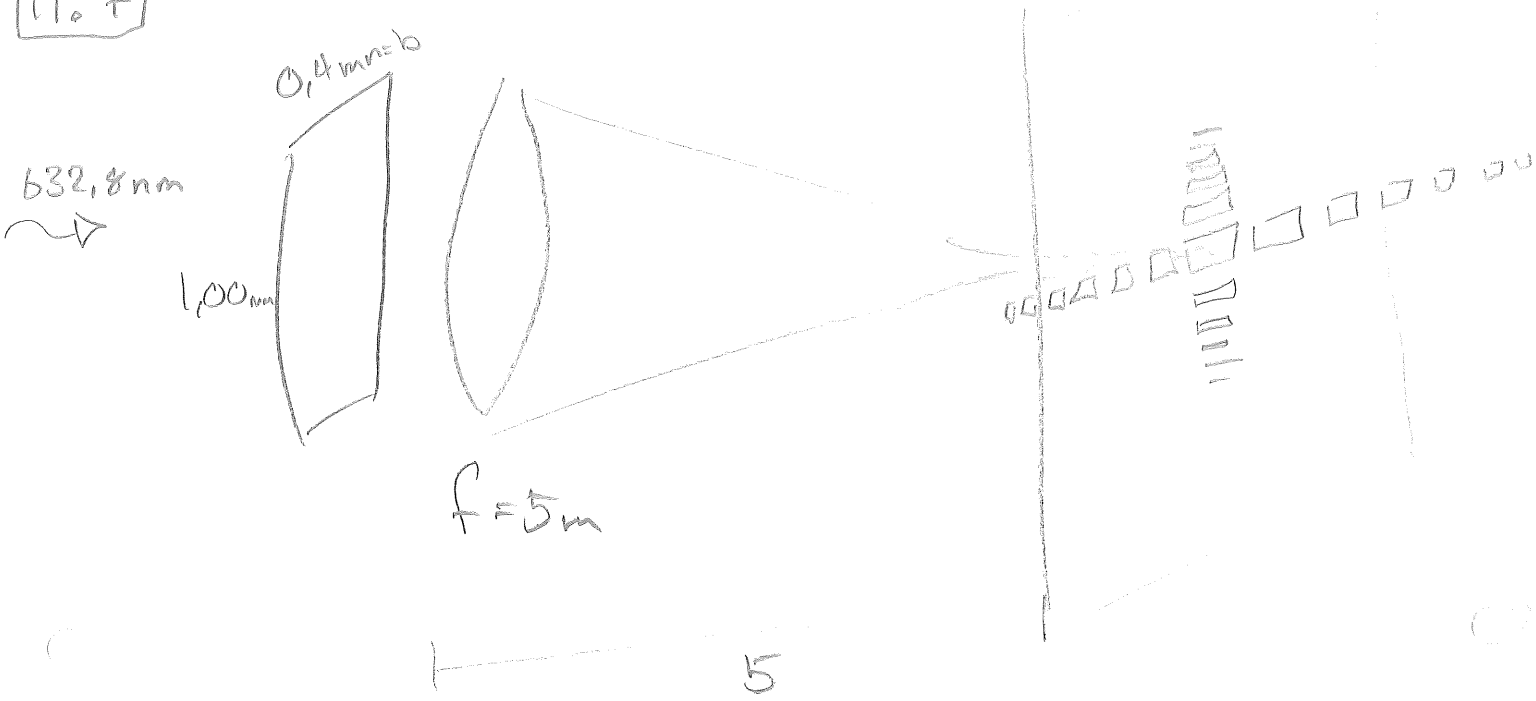
$$D \sin\theta = m\lambda$$

$$\sin\theta = \left(\frac{m\lambda}{D}\right) \Rightarrow \theta = \arcsin\left(\frac{m\lambda}{D}\right) =$$

$m = 1{,}22 \Rightarrow \theta = 35{,}2°$

$m = 2{,}23 \Rightarrow \theta =$ ——— ERROR

11.7



$$2y_m = \frac{m\lambda f}{b} \quad , 2x_m = \frac{n\lambda f}{a}$$

$y_m = 15,8\,mm$ $\qquad$ $x_n = 6,3\,mm$

KAPITEL 12

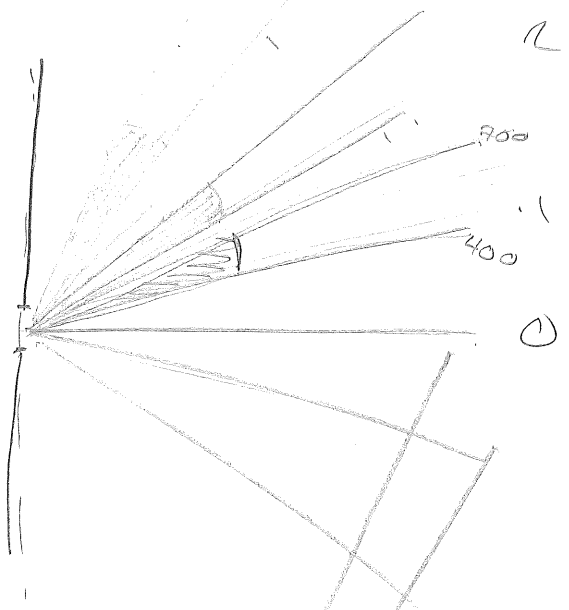
12.1 Luft absorberar [all] strålning under 2000 Å.

12.2

$b = 2{,}00\,\mu m$

$\lambda_1 = 400\,nm$

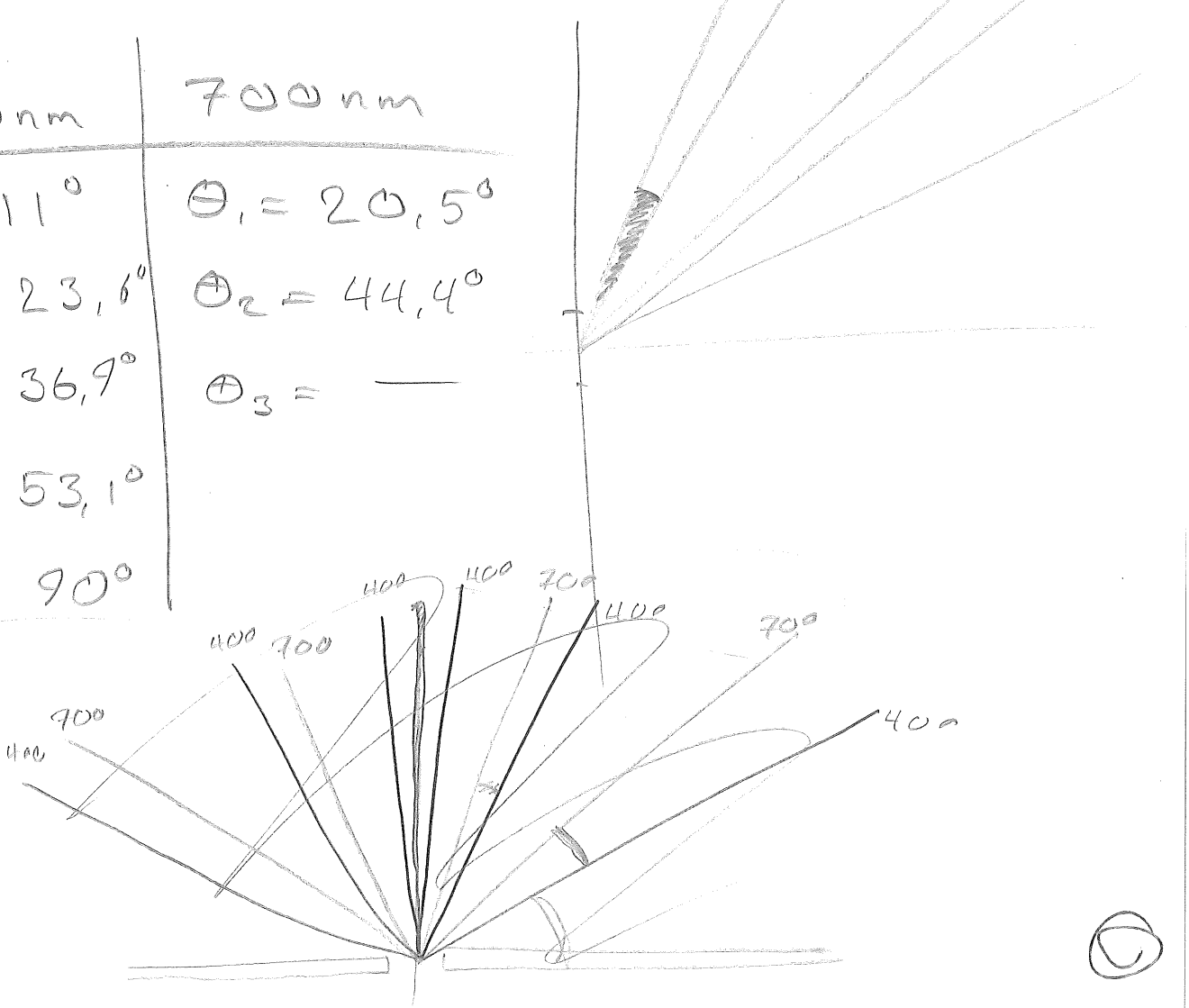
$\lambda_2 = 700\,nm$



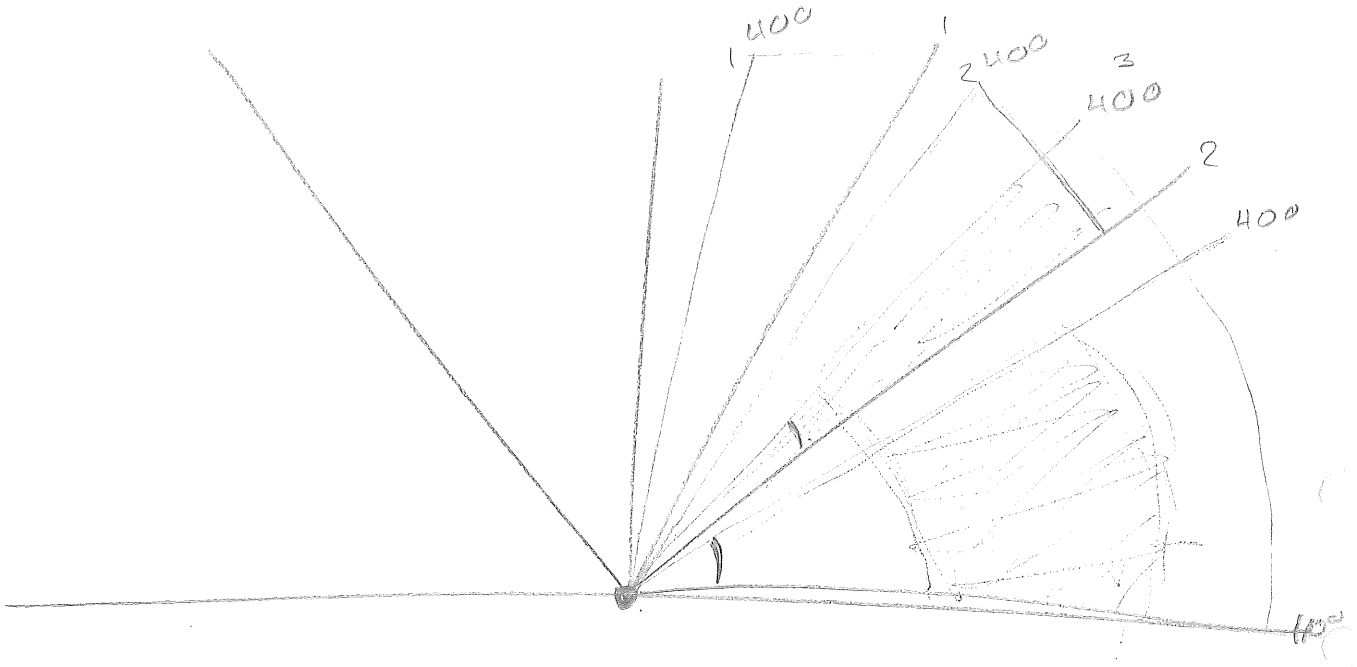
$b(\sin\theta_1 + \sin\theta_m) = m\lambda$

$b\sin\theta_m = m\lambda$

400 nm	700 nm
$\theta_1 = 11°$	$\theta_1 = 20{,}5°$
$\theta_2 = 23{,}6°$	$\theta_2 = 44{,}4°$
$\theta_3 = 36{,}9°$	$\theta_3 =$ —
$\theta_4 = 53{,}1°$	
$\theta_5 = 90°$	



överlappade områden.



~~12.3~~

12.3

1200 ritsar/mm

$b = \frac{1}{1200}\,mm = \frac{1}{1{,}2 \cdot 10^6}\,m$

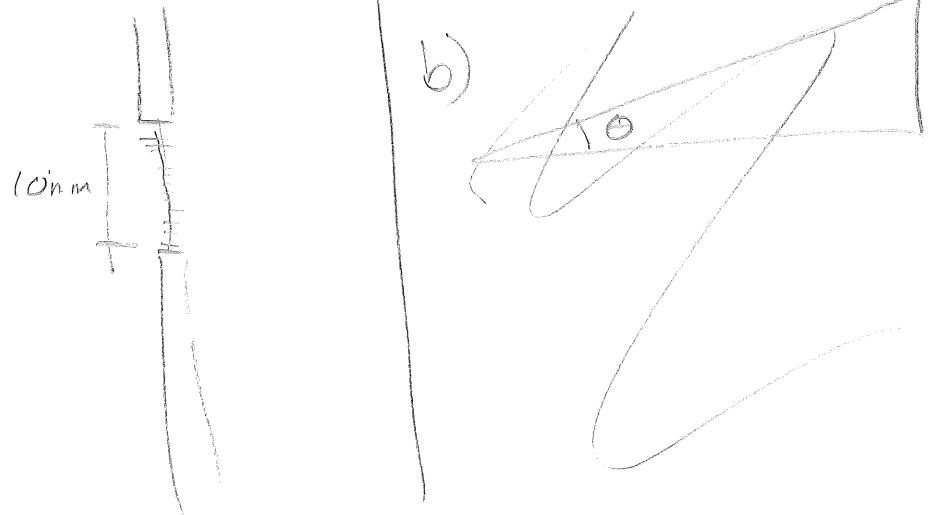
$\lambda = 514 \cdot 10^{-9}\,m$

$\theta_0 = 0°$

a) $b \sin\theta_m = m\lambda$

$\theta_1 = 38°$

b)



12.3

b) Vi vill ha avståndet mellan 1/2

två minima/2 | 1/2

$$I = I_0 \left(\frac{\sin N\alpha}{\sin \alpha}\right)^2$$

Vi vill att $\sin N\alpha = 0$

$$\Rightarrow N\alpha = \pi$$

$$\alpha = \frac{\pi \cdot n}{N}$$

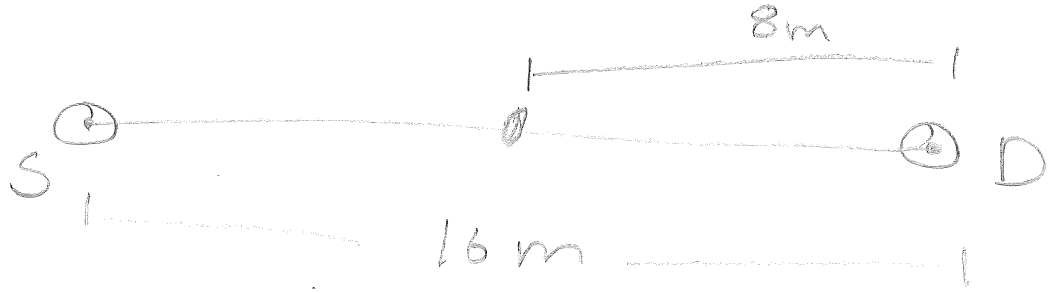
$$\sin \alpha \neq 0 \Rightarrow \alpha \neq \pi \cdot n$$

$$\alpha \neq 0, \pi, 2\pi, 3\pi, \ldots$$

$$\boxed{\alpha = \frac{\pi}{2} \quad N = 2k}$$

13.1

$f_s = 1000\,Hz \qquad v = 340\,m/s$



$$f_n = \frac{R^2}{n\lambda} = \frac{R^2}{n \cdot \frac{v}{f_s}} = \frac{R^2 f_s}{nv}$$

$f_n = 8\,m$

$$R = \sqrt{\frac{f_n n v}{f_s}} \quad n=1 \Rightarrow R = 1{,}65\,m$$

Rätt är $\frac{1{,}65}{\sqrt{2}}$

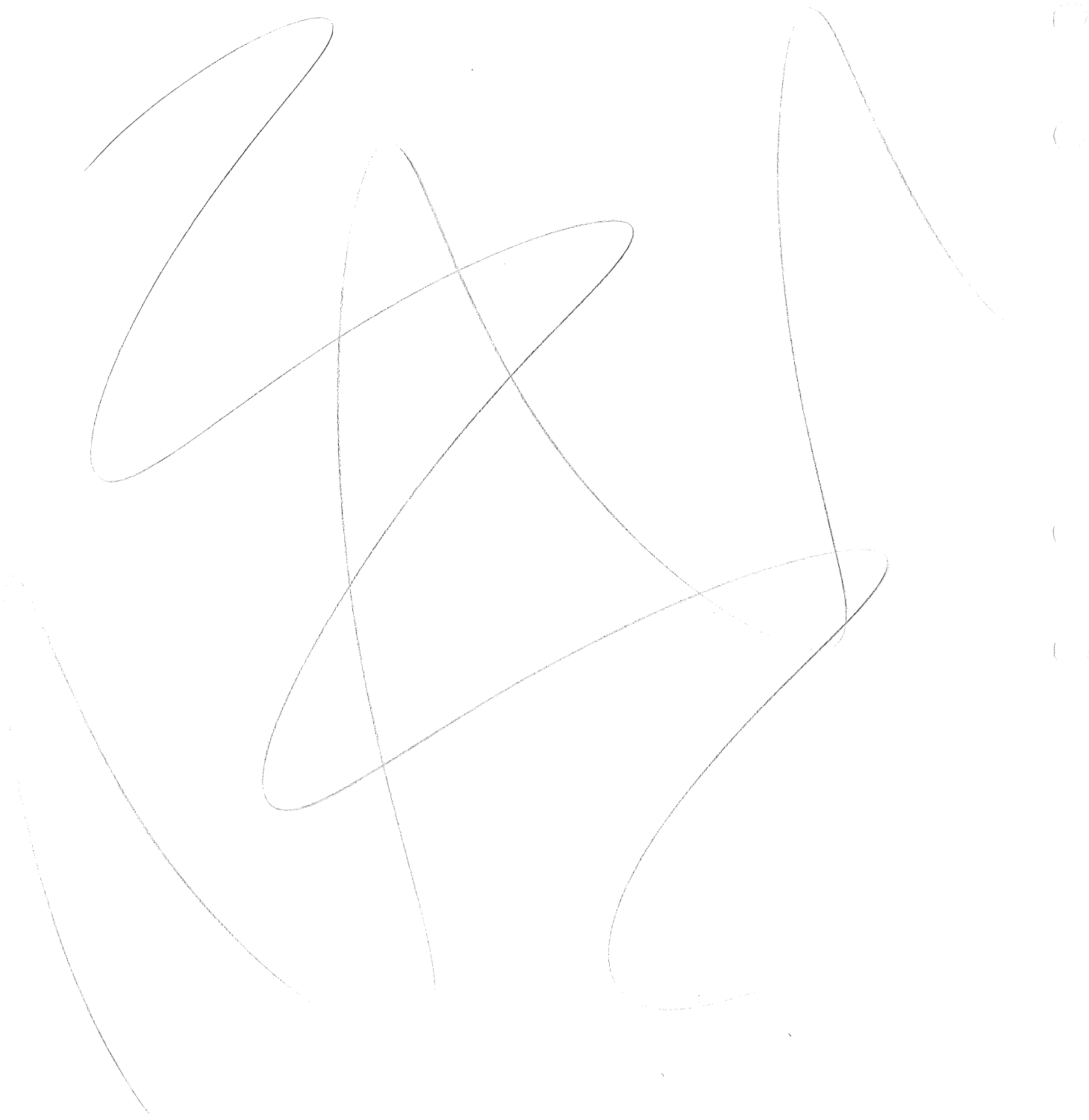
18.24

$R = 3,0\ mm$

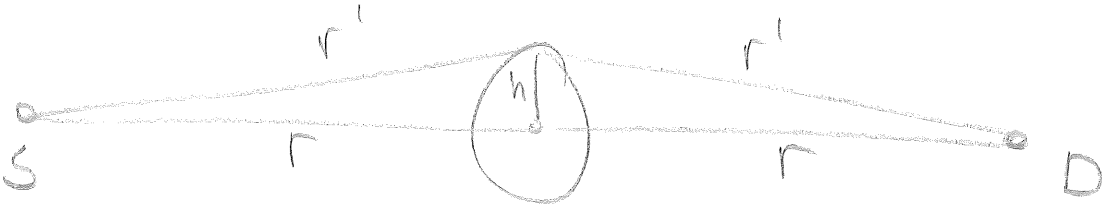
$\lambda = 500\ nm$

$f_n = 2,0\ m$

a) $I_p = I_0 \left(\overline{FG}\right)^2$



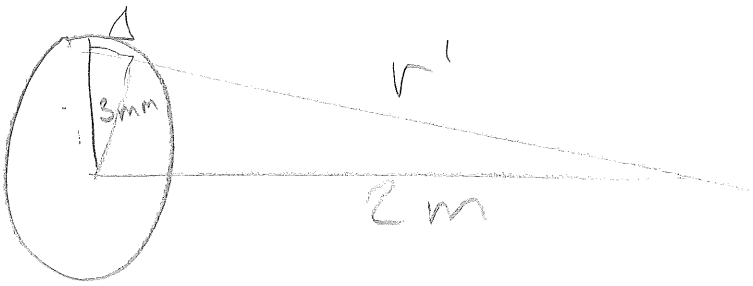
13.1



$$2r + \frac{\lambda}{2} = 2r' \Rightarrow r' = r + \frac{\lambda}{4}$$

$$r^2 + h^2 = (r')^2 \Rightarrow h = \sqrt{\left(r + \frac{\lambda}{4}\right)^2 - r^2} = 1{,}17$$

13.2



$$\sqrt{(3\,mm)^2 + (2\,m)^2} = r'$$

$$\Delta + 2 = r' \Rightarrow \Delta = r' - 2$$

$$\Delta \approx 4{,}5\lambda \Rightarrow n \cdot \frac{\lambda}{2} = 4{,}5\lambda$$

antal fresnelzoner

$$n = 9\,st$$

a) Alla pilar är ~ lika stora.

De åtta första tar ut varandra.

Amplituden på pil nio är lika med amplitud på pil 1, som är 2·Amp utan blandare

$$I = (2 \cdot Amp)^2 = \boxed{4 \cdot I_0} = 9 I_0$$

enpil

b) ~~B~~ $A = (5 \cdot 2 Amp)$

$$I = (5 \cdot 2 Amp)^2 = \boxed{100 I_0}$$

fem st

dubbel amp

2Amp → 2Amp → 2Amp → 2Amp → 2Amp

eller

2amp ← 2Amp ← 2Amp ← 2Amp

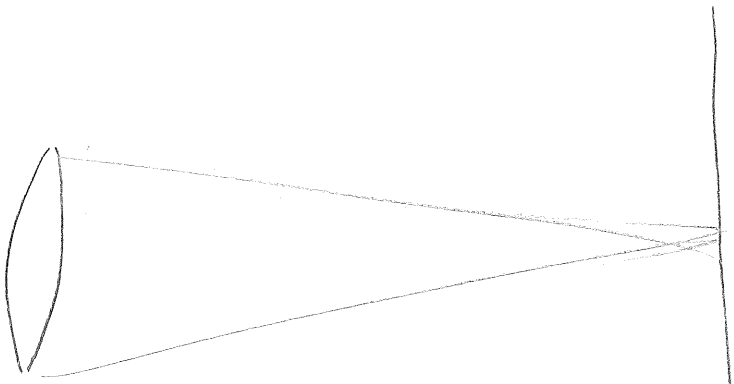
$$I_2 = (4 \cdot 2 Amp)^2 = \boxed{64 I_0}$$

c) ~~B~~

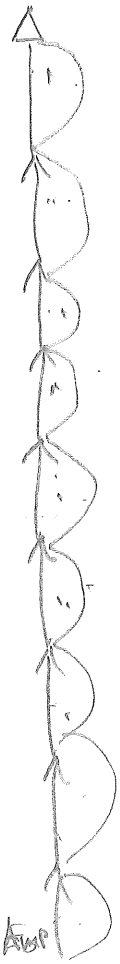
Alla pilar är konstruktiva nu.

$$I = (9.2\,\text{Amp})^2 = \boxed{324\,I_0}$$

d)



Alla strålar är i fas eftersom de gått samma optiska väg.

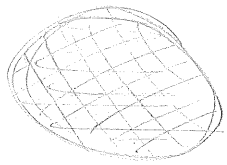


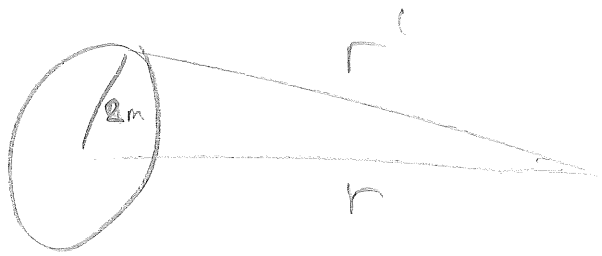
NIO Halvcirklar.
med radie
$a_1/2 = E_0$

$$A_{tot} = \frac{9}{2} 2\pi \frac{a}{2} = 9\pi\,\text{Amp}$$

$$\boxed{I = 81\pi^2 I_0}$$

13.3





Total fasförskjutning: $2 \cdot \frac{\lambda}{2}$ (2 fresnelzoner)

$n = 2$

$(0,004)^2 + r^2 = (r')^2$

$r + 2\frac{\lambda}{2} = r' \Rightarrow r' = r + \lambda$

$0,004^2 + r^2 = (r+\lambda)^2 = r^2 + 2r\lambda + \lambda^2$

$\Rightarrow r = \frac{0,002^2 - \lambda^2}{2\lambda} = 3,16$

n

Gör samma sak för $n=4$
$n=6$

13.3

$$R_n = \sqrt{n r_0 \lambda}$$

$$\Rightarrow r_0 = \frac{R_n^2}{n\lambda}$$

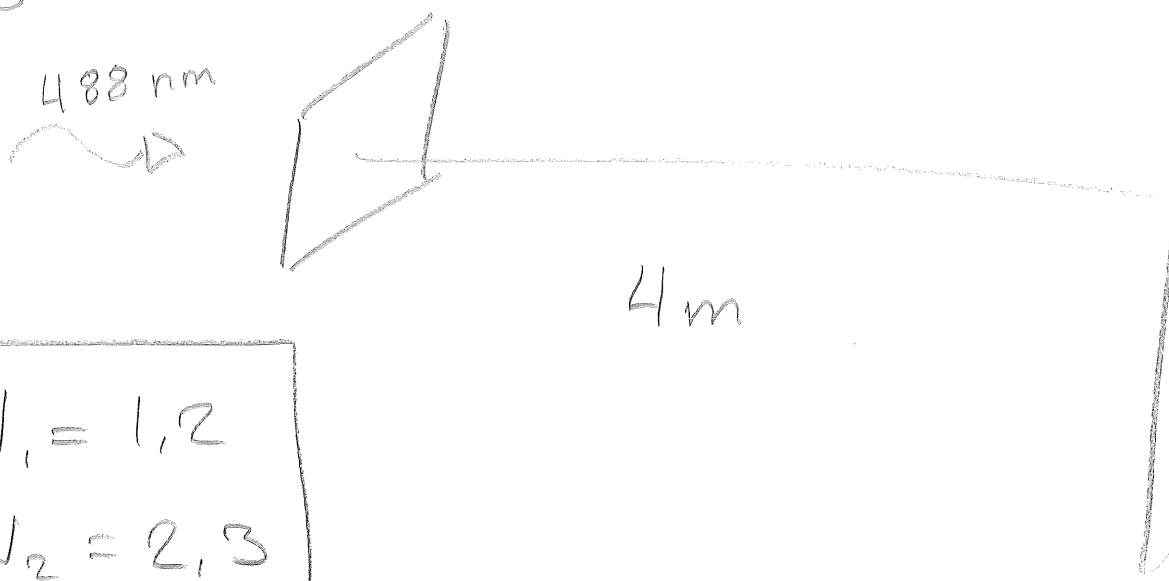
$$r_0 = \frac{0{,}002^2}{633E-9} \cdot \frac{1}{n} = \frac{6{,}32}{n}$$

$n = 2 \Rightarrow r_0 = 3{,}16$

$n = 4 \Rightarrow r_0 = 1{,}58$

$n = 6 \Rightarrow r_0 = 1{,}05$

13.4



$v_1 = 1,2$

$v_2 = 2,3$

$C_1 = 0,7154$, $S_1 = 0,6234$

$C_2 = 0,1266$, $S_2 = 0,5531$

$$I_1 = I_0 \left(\left(C(\infty) + C(v_1) \right)^2 + \left(S(\infty) + S(v_1) \right)^2 \right)$$

$I_1 = 2,74 I_0$ dela med 2

inte grundintensitet

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

$$I_1 = \frac{I_0}{2} \cdot 2,74 = \boxed{1,37 I_0}$$

$$z = v\sqrt{\frac{2\lambda}{L}}$$

$$y = z\left(\frac{p+q}{p}\right)$$

$y = z$ ds $p \to \infty$

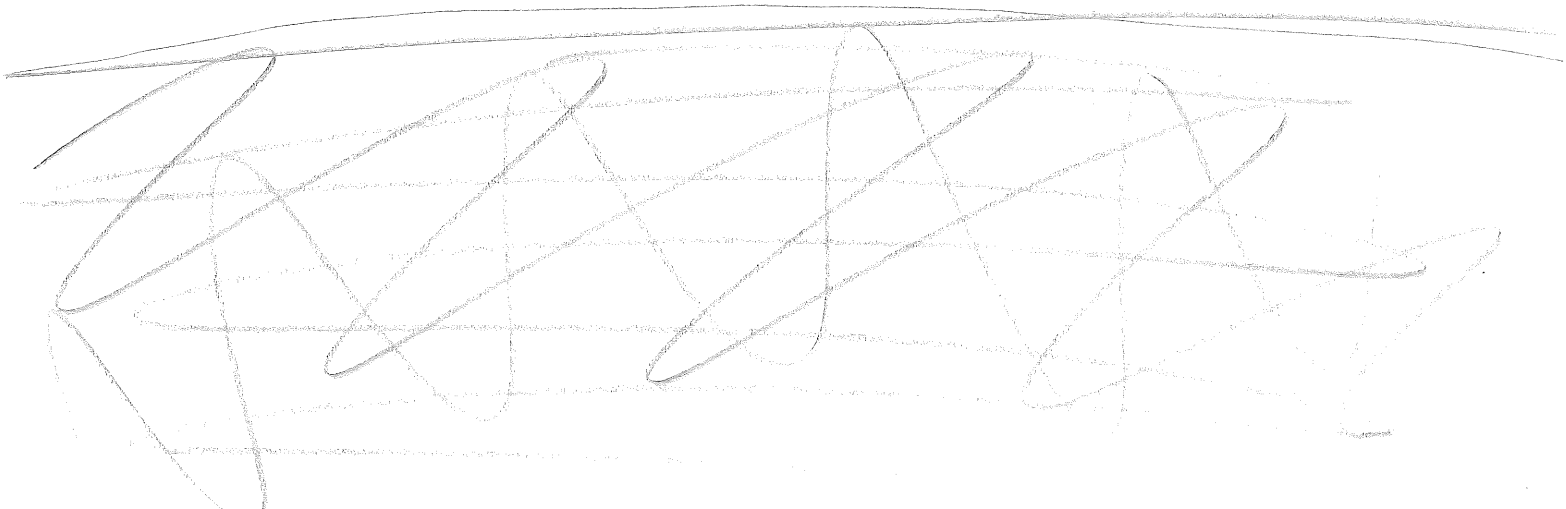
$dy = dz$

$$z_1 = v_1\sqrt{\frac{\lambda}{2\left(\frac{1}{p}+\frac{1}{q}\right)}} \to v_1\sqrt{\frac{\lambda q}{2}}\ ds \quad p\to\infty$$

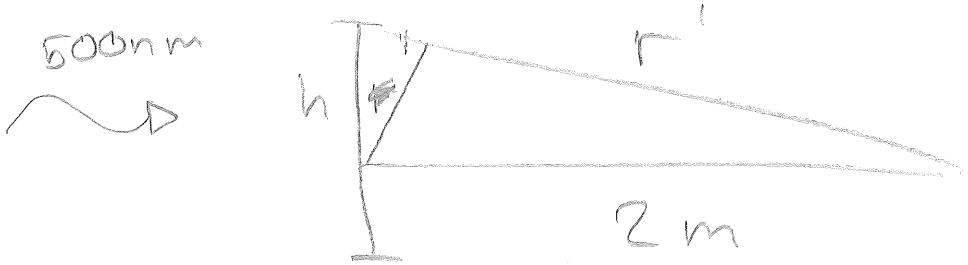
$\boxed{z_1 = 1{,}2\ mm}$

$\boxed{z_2 = 2{,}3\ mm}$

$\boxed{dy = dz = 1{,}1\ mm}$



13.5



$$h^2 + 2^2 = |r'|^2$$

$$2 + \Delta = r'$$

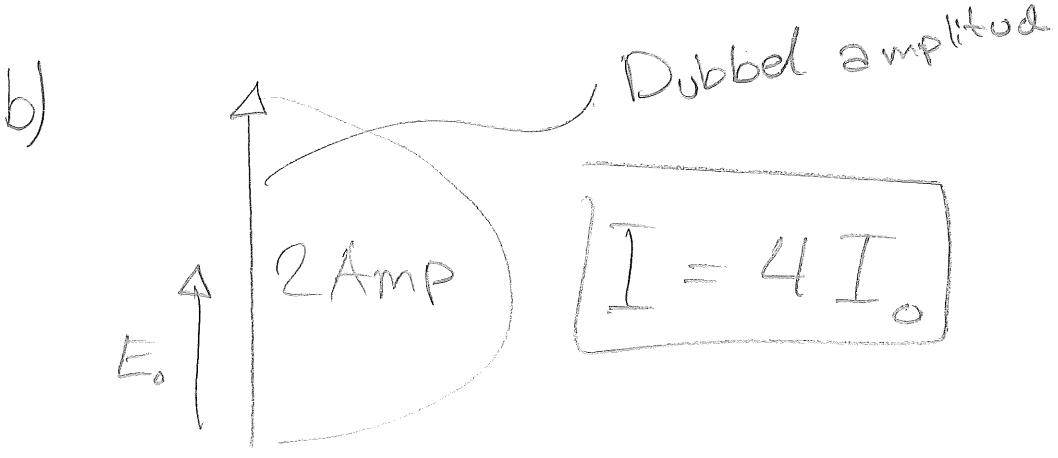
$$\Delta = \frac{\lambda}{2}$$

$$\Rightarrow r' = 2 + \frac{\lambda}{2}$$

$$h^2 = \left(2 + \frac{\lambda}{2}\right)^2 - 4 = 10^{-6}\ m^2$$

a) $h = 0{,}001\ m = \boxed{1\ mm}$

b)

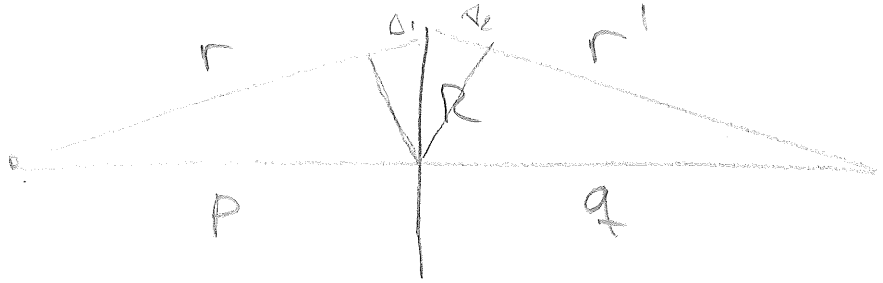


$$\boxed{I = 4I_0}$$

c)

$$I = \left(\frac{1}{2} \cdot 2E_0 \sigma_1\right)^2 = \boxed{\sigma^2 I_0}$$

13.6



$$r^2 - p^2 = R^2 = r'^2 - q^2$$

$$p + \Delta_1 = r$$

$$q + \Delta_2 = r'$$

$$\Rightarrow \boxed{p + q + \Delta_1 + \Delta_2 = r + r'}$$

$$\boxed{\Delta_1 + \Delta_2 = n\frac{\lambda}{2}}$$

$$q^2 + R^2 = (q + \Delta_2)^2$$

$$\boxed{\Delta_2 = \sqrt{q^2 + R^2} - q}$$

$$\boxed{\Delta_1 = \sqrt{p^2 + R^2} - p}$$

$$\sqrt{p^2+R^2}-p+\sqrt{q^2+R^2}-q=n\frac{\lambda}{2}$$

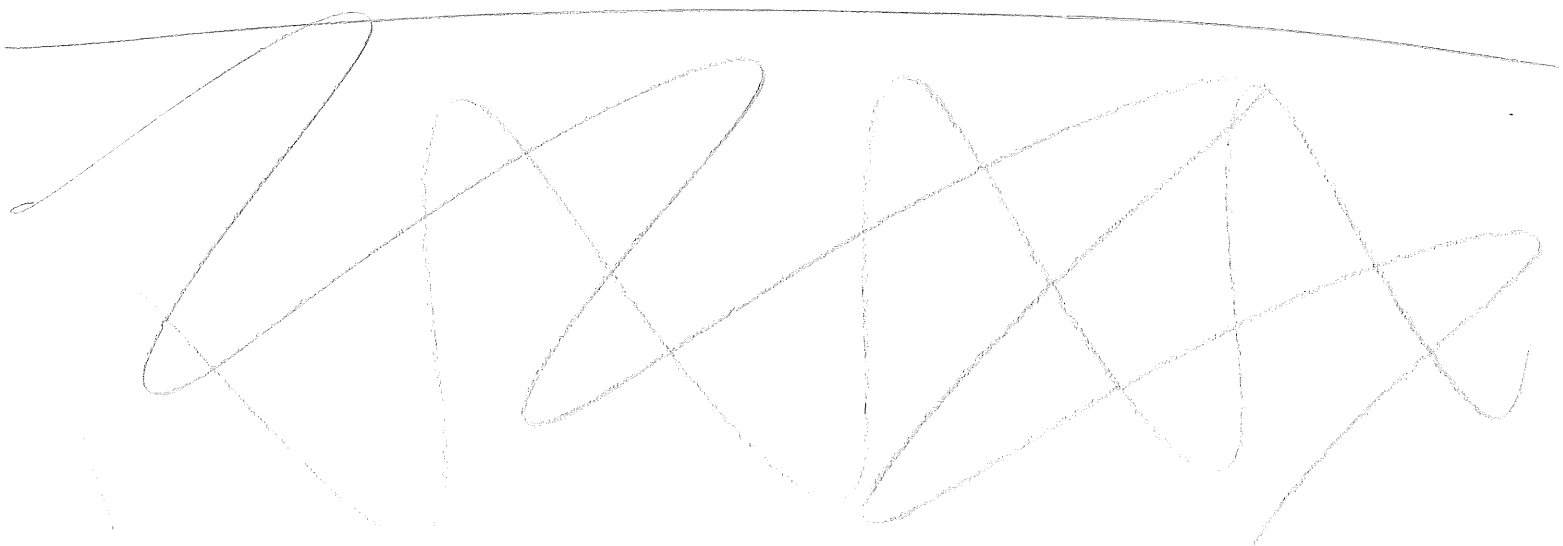
$$\Leftrightarrow\quad p+\frac{R^2}{2p}-p+q+\frac{R^2}{2q}-q=n\frac{\lambda}{2}$$

$$\frac{R^2}{2}\left(\frac{1}{p}+\frac{1}{q}\right)=n\frac{\lambda}{2}$$

$$\frac{R^2}{2}\cdot\frac{1}{L}=n\frac{\lambda}{2}$$

$$\Leftrightarrow\quad \boxed{R=\sqrt{n\lambda L}}$$

ezpz.



15.1 Kanske kan vi linjärpolarisera circ-pol-ljus.

15.2 Vid reflektion bildas lin-pol-ljus. Polaroidglasögon är lin pol åt ena hållet.

15.3

$\theta_1 = \theta$, $\theta_2 = 90 - \theta$

a) $\boxed{I_0 \cos^2\theta \cdot \sin^2\theta}$

$\omega \cdot t = \theta$

b) $I = \frac{I_0}{4} \sin^2 2\theta = \boxed{\frac{I_0}{4} \sin^2(2\omega t)}$

15.4

a) Inget

b) $I_0 \cos^2 45° \cdot \cos^2 45° = I_0 \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{I_0}{4}$

c) $I_0 \cos^6 30° = I_0 \cdot \frac{\sqrt{3}^6}{2^6} = I_0 \frac{27}{64} \approx 0{,}42 I_0$

d) $I_0 \cos^{2N}(90°/N)$

$\frac{1}{x} = k$ $\quad x \to \infty \Rightarrow k \Rightarrow 0$

e) $\cos^x\left(\frac{1}{x}\right) = \cos^{1/k}(k) = y$

$\ln y = \ln \cos^{1/k}(k)$

$\ln y = \frac{1}{k} \cdot \ln(\cos k) = \frac{\ln(\cos k)}{k}$

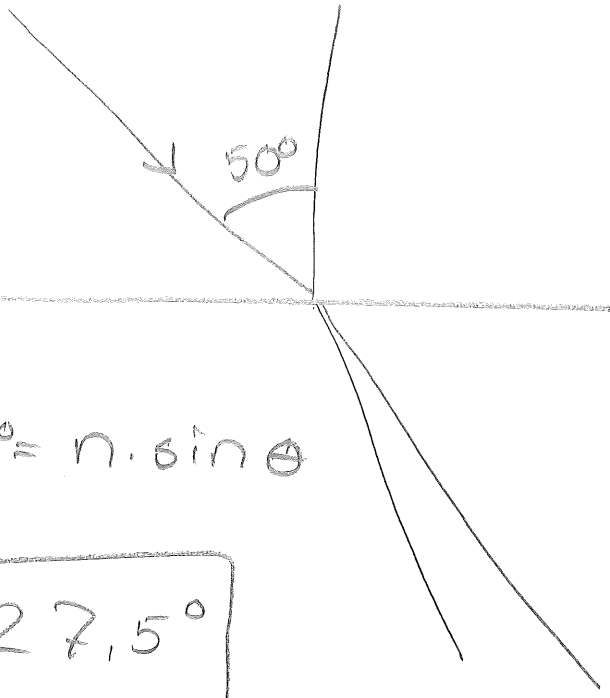
L'Hospital

$\frac{-\frac{1}{\cos k} \cdot \sin k}{1} = -\tan k \to 0$ då $k \to 0$

$\ln y = 0 \Rightarrow y = 1$

$I \to I_0 \cdot 1$ då $N \to \infty$

15.5



$n_o = 1{,}6584$

$n_e = 1{,}4864$

$\sin 50° = n \cdot \sin\theta$

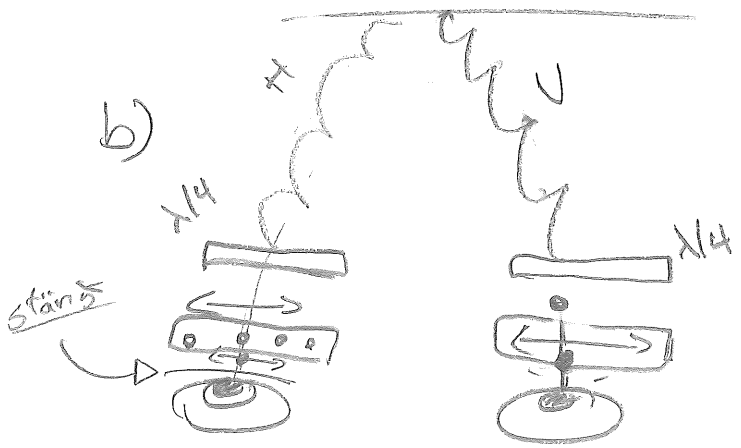
$\theta_o = 27{,}5°$

$\theta_e = 31°$

15.6 Innan: Två pol som gör circ. -pol H/L

a) Först $\frac{\lambda}{4}$-plate. $\Rightarrow$ linjeras

sedan linj-pol.



15.7

a) $\boxed{\frac{\lambda}{4} = d(n_e - n_o)}$

$\lambda = 486\,nm$

$n_e = 1{,}559$

$n_o = 1{,}54197$

$$\Rightarrow d = \frac{\lambda}{4(n_e - n_o)} = \boxed{13\,\mu m}$$

b)

FALL 1

Inkommande: $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$ $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$

$$A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} = B$$

$$AB = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$

$$\boxed{AB\,\vec{1} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}}$$

15.8

$\Delta n = |n_e - n_o|$

λ_0 =

d: tjocklek

$\lambda_0 \Delta\theta = 2\pi d \Delta n$