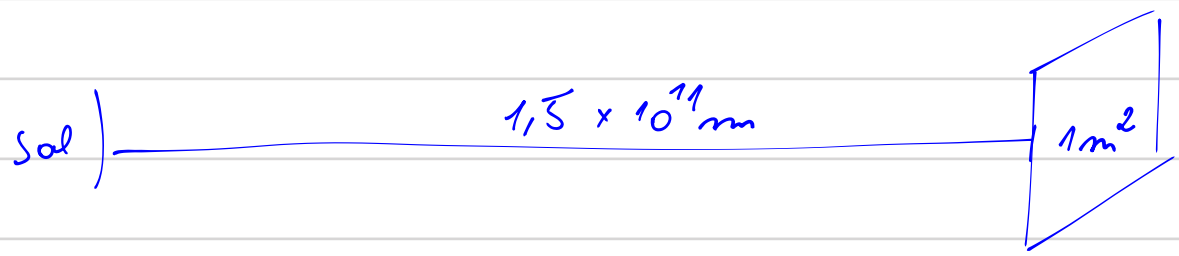
P1 - Q1

	$\psi_1 =$	$\psi_2 =$
	$-4 \operatorname{Sen}[0{,}4\pi x - 6\pi t]$	$\frac{5}{2} \cos[8z + 3{,}5t]$
frequência (ω)	$\omega = 6\pi$	$\omega = 3{,}5$
comprimento de onda (λ)	$k = \frac{2\pi}{\lambda} = 0{,}4\pi$ $\quad \lambda = 5\,m$	$k = 8 = \frac{2\pi}{\lambda}$ $\quad \lambda = 0{,}25\pi\,m$
período temporal (T)	$\omega = 2\pi f = \frac{2\pi}{T} = 6\pi$ $\quad T = \frac{1}{3}\,s$	$\omega = 2\pi f = 3{,}5 = \frac{2\pi}{T}$ $\quad T = 0{,}6\pi\,s$
período espacial (λ)		
amplitude ψ_0	$\psi_0 = 4$	$\psi_0 = 5/2$
velocidade da onda v	$v = \lambda f = 5 \cdot \frac{1}{3} = 5/3 \frac{m}{s}$	$v = (0{,}25\pi) \cdot (1/0{,}6\pi) = 0{,}42 \frac{m}{s}$
direção de propagação	$+\hat{x}$	$-\hat{z}$

$$\psi = \psi_0 \operatorname{Sen}[kx - \omega t + \varepsilon]$$

$\hat{x}$

$$\langle S(t) \rangle = 1{,}4 \times 10^3 \frac{W}{m^2}$$



a) $\langle S(t) \rangle = I = 1{,}4 \times 10^3\ W/m^2$

$$\text{Pressão} = \frac{I}{c} = \frac{1{,}4 \times 10^3\ W/m^2}{3 \times 10^8\ m/s} = 0{,}46 \times 10^{-5} \frac{J}{m^2} \cdot \frac{s}{m}$$

$$\boxed{\text{Pressão} = 4{,}6\ \frac{\mu J}{m^3}}$$

b) $2\% \rightarrow$ Visível $\qquad \frac{I}{E_f} = 1{,}4 \times 10^3 \frac{W}{m^2}$

$$E_f = \frac{hc}{\lambda} = \frac{6{,}6 \times 10^{-34} \cdot 3 \times 10^8\ m/s}{500 \times 10^{-9}\ m} = 1 \quad 1\,J$$

N° fótons no visível $= \left(\frac{I}{\quad} \right) \times 0{,}02 = \sim 10^{23}$ fótons

E_f)

c) $E(x,t) = E_0 \, \mathrm{Sen}\,[Kx - \omega t + \varepsilon]$ $\qquad \varepsilon = 0$

luz verde $= 550\ nm = \lambda$

$$\omega = 2\pi f = \frac{2\pi c}{\lambda} = \frac{2\pi \cdot 3\times10^{8}}{550\times10^{-9}}\ \frac{rad}{s} = 0{,}03\times10^{17} = 3\times10^{15}\ \frac{rad}{s}$$

$$K = \frac{2\pi}{\lambda} = (0{,}011\times10^{9})\ m^{-1} = 1{,}1\times10^{9}\ m^{-1}$$

$$I = \langle S(t) \rangle = \frac{\varepsilon_0 c}{2} E_0^2 = 1{,}4\times10^{3}\ W/m^2$$

$$E_0^2 = \frac{2\times1{,}4\times10^{3}}{8{,}8\times10^{-12}\times3\times10^{8}} = 0{,}10\times10^{7}\ \frac{V}{m}$$

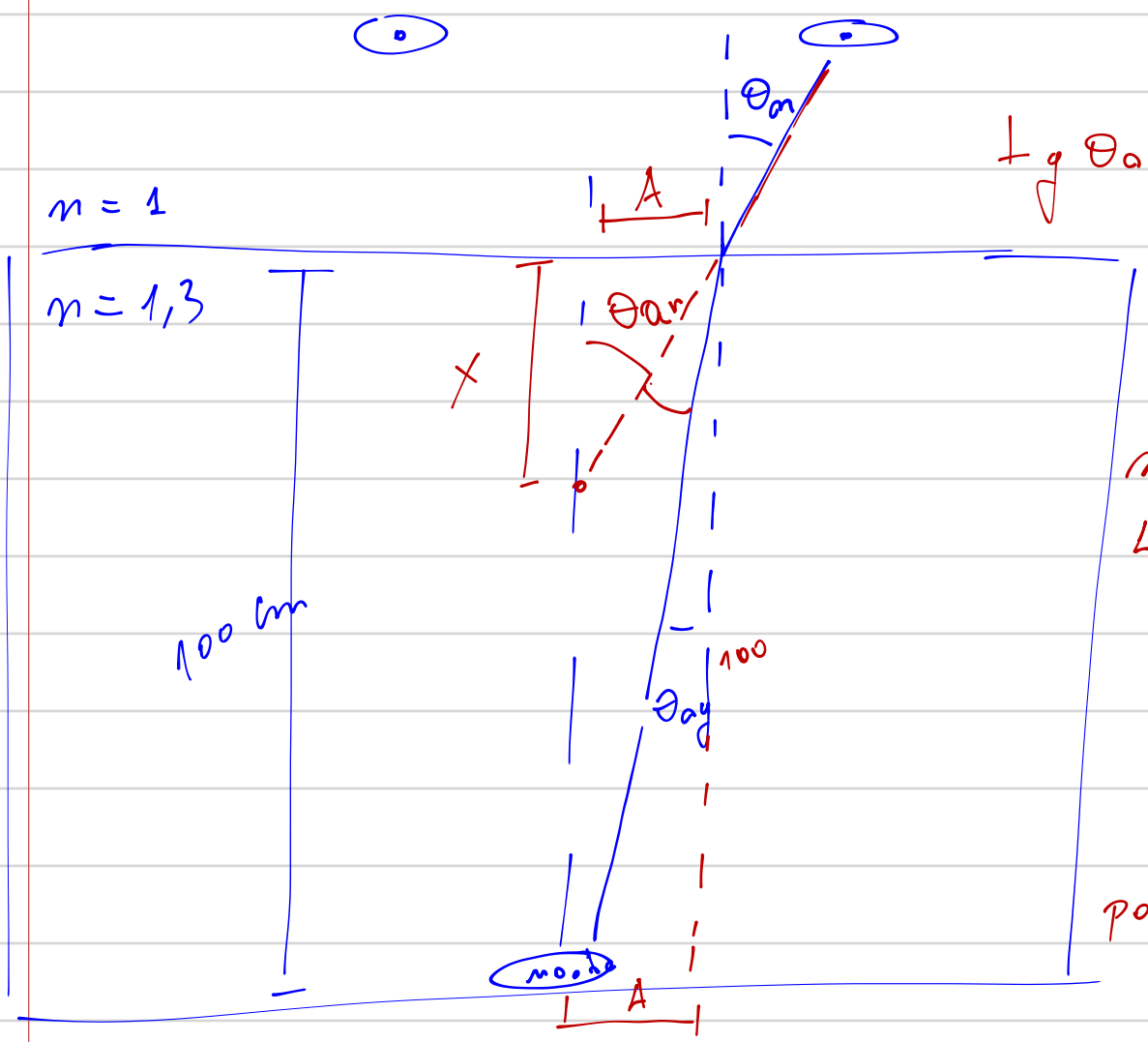
$1{,}06\times10^{6}$

10^{5} $\quad 10^{7}$

$\varepsilon_0 = 8{,}8\times10^{-12}\ F/m$

$$\boxed{E_0 = 1029\ V/m}$$

P1.-Q3



θ_{ar} e θ_{ag} = pequenos

$tg\,\theta_a \simeq \mathrm{Sen}\,\theta \simeq \theta$

$$\theta_{ar} = \frac{A}{X} \qquad \theta_{ag} = \frac{A}{100}$$

$n_{ar}\,\theta_{ar} = n_{ag}\cdot\theta_{ag}$

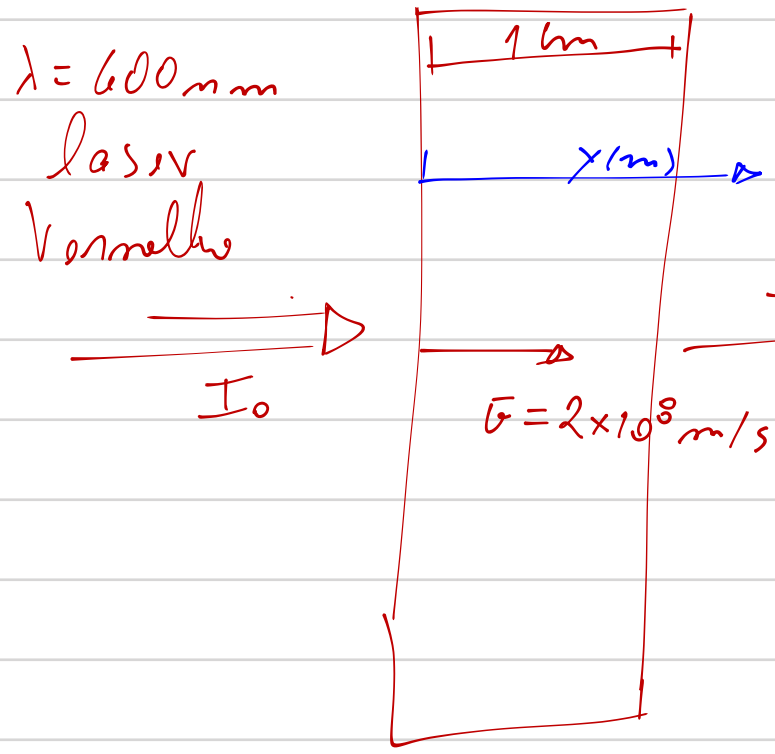
$$1 \cdot \frac{A}{X} = 1{,}3 \cdot \frac{A}{100}$$

$$X = \frac{100}{1{,}3} = 77\ cm$$

posição a partir do nível

$\therefore$ 77 cm

P1-Q4



$n = n_R - i n_I$

$n_R = \frac{c}{v} = \frac{3\times10^8}{2\times10^8}$

$\boxed{n_R = 1,5}$

$I = I_0 e^{-\alpha y}$ $\quad \alpha =$ Coef de atn.

$\alpha = \frac{2 n_I \omega}{c}$

$\alpha = \frac{2 n_I \, 2\pi \cancel{c}}{\cancel{c}\,\lambda}$ $\quad \alpha = \frac{4\pi n_I}{\lambda}$

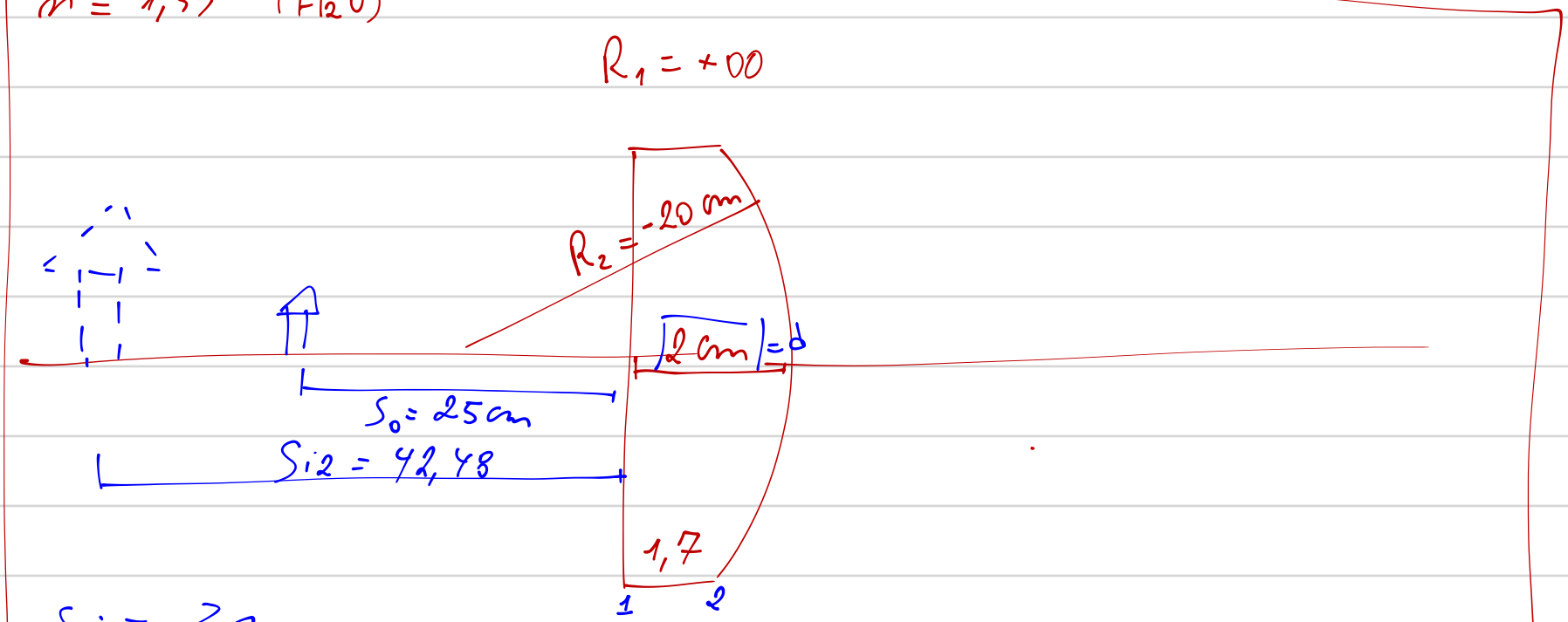
$I = \frac{I_0}{2} = I_0 e^{-\frac{4\pi n_I}{\lambda} \cdot y}$

$\ln(1/2) = -\frac{4\pi n_I}{600\times10^{-7}\,m} \cdot 10^{-2} m = -0,693$ $\quad n_I = 3,3\times10^{-6}$

$\boxed{n = 1,5 - i(3,3\times10^{-6})}$

P1- Q5

$n = 1,33$ (H_2O)



$S_i = ?$

$\frac{n_m}{S_{o1}} + \frac{n_m}{S_{i2}} = (n_l - n_m)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) + \frac{n_l \cdot d}{(S_{i1} - d)\cdot S_{i1}}$

S_{i1} = imagem formada após passar pela face 1

?

p/ a face 1

$$\frac{n_m}{s_{o1}} + \frac{n_l}{s_{i1}} = \frac{n_e - n_m}{R_1}$$

$$\frac{1,33}{25\,cm} + \frac{1,7}{s_{i1}} = \frac{1,7-1,3}{\infty} = 0$$

$$\boxed{s_{i1} = -32,69\,cm}$$

$$\frac{1,33}{25} + \frac{1,33}{s_{i2}} = (1,7-1,33)\left(\frac{1}{\infty} + \frac{1}{+20}\right) + \boxed{\frac{1,7 \cdot 2\,cm}{(-32,69-2)\cdot(-32,69}}$$

$$0,0532 + \frac{1,33}{s_{i2}} = 0,0185 + \boxed{0,003388}$$

$$\boxed{s_{i2} = -42,48\,cm}$$