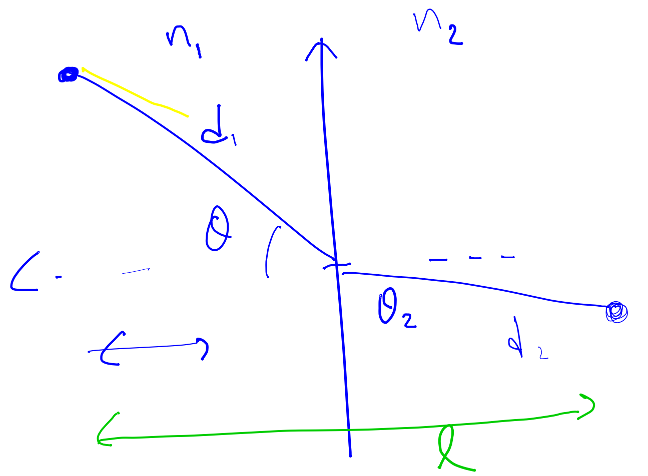
91 Snell's law s $\frac{n}{n_2} \quad \frac{s\,n\,\theta_2}{s\,n\,\theta}$

Fermat's principle: ray of light chooses path that minimizes time to ...



total time $= \frac{d}{V_2} \quad \frac{d_2}{V_2}$

since $n \quad \frac{c}{V}$ $\quad \frac{d_1}{c_n} \quad \frac{d_2}{c\,n_2}$

$$- \frac{\sqrt{\;2 \quad 2}}{c_n} \quad \frac{\sqrt{h_2^2 \quad (\ell \;\;)^2}}{c_{n_2}}$$

$\frac{d}{dx} - 0$ would give us the e ... (hopefully minimum

$\Rightarrow \quad n \underbrace{\frac{x}{\sqrt{\;^2 \quad h^2}}}_{\sin\theta} \qquad n_2 \underbrace{\frac{(-\;)}{\sqrt{(\;\; \quad h_2^2}}}_{s\,n\,\theta_2}$

92 a) Fresnel's eq.

$$E_2 = \frac{2\sin\theta_2\cos\theta_0}{\sin(\theta_2-\theta_0)} E_0$$

$$E = \frac{\sin(\theta_2 \quad \theta_0)}{\sin(\theta_2 \quad \theta_0)} E_0$$

perp to plane of incidence

$$E = \frac{\tan(\theta_0-\theta_2)}{\tan(\theta_0-\theta_2)} E_0$$

$$E_2 = \frac{2\cos\theta_0\sin\theta_2}{\sin(\theta_0-\theta_2)\cos(\theta_0-\theta_2)} E_0$$

parallel to plane of incidence

$$\vec{P} \quad \vec{E} \quad \vec{\ } \quad \vec{E} \quad \sqrt{\frac{\varepsilon}{\mu}}\hat{n} \quad \vec{E} - \sqrt{\frac{\varepsilon}{\mu}} E^2\hat{n} - \frac{n}{\mu c}E^2\hat{n}$$

cos $n \quad \sqrt{\mu\varepsilon}$

Reflectivity $R = \frac{E^2}{E_0^2}$

$$R = \frac{\tan^2(\theta_0 \quad \theta_2)}{\tan^2(\theta_0 \quad \theta_2)} \qquad R \quad \frac{\sin^2(\theta_2 \quad \theta_0)}{\sin^2(\theta \quad \theta_0)}$$

$$T = \frac{n_2}{n_0}\frac{|E_2|^2}{E_0^2} \qquad \frac{n_2}{n_0}\frac{4\sin^2\theta_2\cos^2\theta_0}{\sin^2(\theta_1 \quad \theta_0)}$$

can use Snell's law to simplify...

$$= \frac{n_2 \, 4 \cos^2\theta_0 \sin^2\theta_2}{n \sin^2(\theta_0 \ \theta_2) \cos^2(\theta_0 - \theta_2)}$$

b) $$R \quad \frac{\sin^2(\theta_2 \ \theta_0)}{\sin^2(\theta_2 \ \theta_0)}$$

since this is reflected we know that $\theta_0 - \theta$

we also know (Snel's) that $\frac{\sin\theta}{\sin\theta_2} \quad \frac{n_2}{n}$

when $\theta > 0 \quad \theta \quad \frac{n_2}{n}\theta_2$

$$\therefore R \approx \frac{\left\{\sin\left[\theta_2 \left(\frac{n_2}{n}\right)\right]\right\}^2}{\left\{\sin\left[\theta_2 \left(\frac{n_2}{n}\right)\right]\right\}^2}$$

$$\approx \frac{\left(\frac{n_2}{n}\right)^2}{\left(\frac{n_2}{n}\right)^2} \qquad \frac{(n \ \ n_2)^2}{(n - n_2)}$$

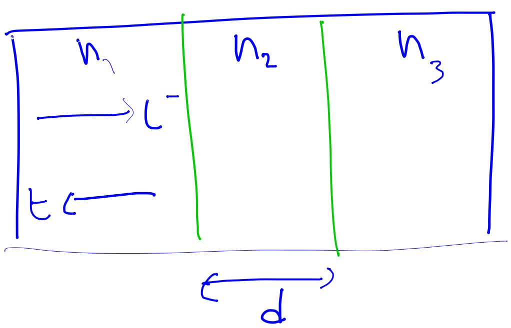
$= 0.04$ when n $n_2 = s$

c) From book $\tan\theta_{brewster} = \frac{n_2}{n}$

$\Rightarrow \theta_{brews} = \tan^{-1}\left(\frac{1.5}{1}\right) = 56.3^{\circ}$

d) $\theta_{crit} = \sin^{-1}\left(\frac{n_2}{n}\right) = 41.8^{\circ}$

9.3

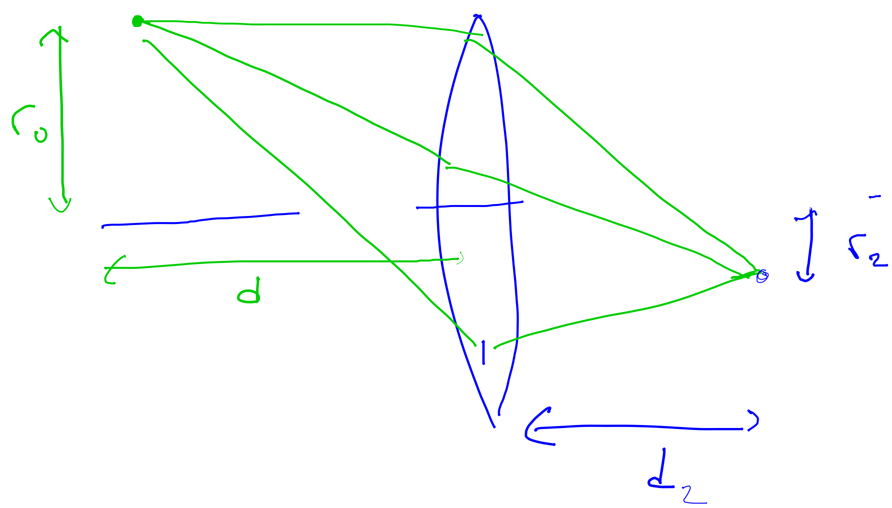


From before we know that $R = \frac{\sin(\theta_2 - \theta_0)}{\sin(\theta_2 + \theta_0)}$

(prob 9.2b)

$\approx \frac{n_2 - n}{n + n_2}$??

9.4



ray matrix for lens

$$\begin{bmatrix} 1 & 0 \\ -\frac{1}{f} & 1 \end{bmatrix}$$

from eq. 9.37

$$\begin{bmatrix} 1 & d_2 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ -\frac{1}{f} & 1 \end{bmatrix} \begin{bmatrix} 1 & d_1 \\ 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 1 - d_2/f & d + d_2\left(1 - d/f\right) \\ -1/f & 1 - d/f \end{bmatrix}$$

$\overline{\Pi}$

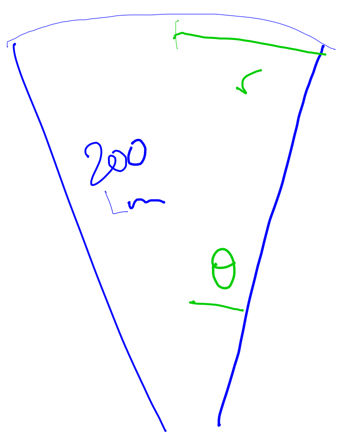
9 5/a) $\theta - \frac{\lambda}{nW}$ $\quad \frac{790 \quad 0^{9}}{-\ 1 \quad 0^{6} m}$ $\quad$ 0·25 rad

n ; n air

b) $\lambda - \pi n w \theta$

78 nm $\quad$ / rays?

c) Divergence angle θ $\quad \frac{600 \quad 0^{9}}{\quad \underbrace{0^{2}}_{\text{compare}}}$ $\quad$ ·9 $\quad 0^{5}$ rad.



$\tan\theta \quad \frac{r}{200 \quad 0^{3}}$

$\rightarrow r \approx 38\,m$