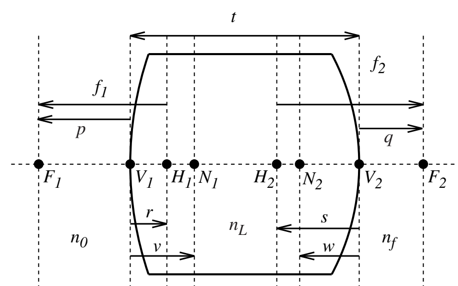
Equation sheet for PHY 300 exam 2 as of November 4, 2008. You will be given this sheet in class.

$+R$ is with center of curvature "downstream"

$$\frac{n_1}{s_1}+\frac{n_2}{s_1'}=\frac{n_2-n_1}{R_1} \qquad \frac{1}{f}=\frac{n_2-n_1}{n_1}\Big(\frac{1}{R_1}-\frac{1}{R_2}\Big) \qquad \frac{1}{s}+\frac{1}{s'}=\frac{1}{f} \qquad \frac{1}{f}=\frac{2}{R} \qquad m=-\frac{n_1 s'}{n_2 s}$$

$$\mathcal{T}=\left[\begin{array}{cc} 1 & 0 \\ L & 1 \end{array}\right],\ \mathcal{R}=\left[\begin{array}{cc} \frac{n}{n'} & \frac{1}{R}\left(\frac{n}{n'}-1\right) \\ 0 & 1 \end{array}\right],\ \mathcal{L}=\left[\begin{array}{cc} 1 & \frac{2}{R} \\ 0 & 1 \end{array}\right],\ \mathcal{F}=\left[\begin{array}{cc} 1 & -\frac{1}{f} \\ 0 & 1 \end{array}\right] \text{ for } \left[\begin{array}{c} \alpha \\ y \end{array}\right]$$

$$\begin{aligned}
f_1 &= \frac{n_0/n_f}{B} \\
f_2 &= \frac{-1}{B} \\
r &= \frac{A-n_0/n_f}{B} \\
s &= \frac{1-D}{B} \\
v &= \frac{A-1}{B} \\
w &= \frac{n_0/n_f-D}{B} \\
1 &= -\frac{f_1}{s}+\frac{f_2}{s'} \\
m &= -\frac{n_0 s}{n_f s'}
\end{aligned}$$



$$\left[\begin{array}{cc} A & B \\ C & D \end{array}\right]$$

$$a(Q)=-\frac{y^4}{8}\Big[\frac{n_1}{s}\left(\frac{1}{s}+\frac{1}{R}\right)^2+\frac{n_2}{s'}\left(\frac{1}{s'}-\frac{1}{R}\right)^2\Big] \qquad b_y=\frac{s'}{n_2}\frac{da}{dy} \qquad b_z=\frac{s'}{y}b_y \qquad \sigma=\frac{R_2+R_1}{R_2-R_1}$$

$$\frac{1}{f_D}=(n_{1D}-1)\frac{2}{|r_1|}\frac{V_1-V_2}{V_1} \qquad \frac{1}{r_{22}}=\frac{1}{|r_1|}\left[2\frac{(n_{1D}-1)}{(n_{2D}-1)}\frac{V_2}{V_1}-1\right] \qquad V\equiv\frac{n_D-1}{n_F-n_C}$$

$$\lambda_F=486.1\text{ nm} \qquad \lambda_D=587.6\text{ nm} \qquad \lambda_C=656.3\text{ nm}$$

$$\begin{aligned}
\text{TE: } r_\perp &= \frac{\cos\theta-\sqrt{n^2-\sin^2\theta}}{\cos\theta+\sqrt{n^2-\sin^2\theta}}=-\frac{\sin(\theta_i-\theta_t)}{\sin(\theta_i+\theta_t)} \\
\text{TM: } r_\parallel &= \frac{n^2\cos\theta-\sqrt{n^2-\sin^2\theta}}{n^2\cos\theta+\sqrt{n^2-\sin^2\theta}}=\frac{\tan(\theta_i-\theta_t)}{\tan(\theta_i+\theta_t)} \\
\text{TE: } t_\perp &= \frac{2\cos\theta}{\cos\theta+\sqrt{n^2-\sin^2\theta}}=\frac{2\sin\theta_t\cos\theta_i}{\sin(\theta_i+\theta_t)} \\
\text{TM: } t_\parallel &= \frac{2n\cos\theta}{n^2\cos\theta+\sqrt{n^2-\sin^2\theta}}=\frac{2\sin\theta_t\cos\theta_i}{\sin(\theta_i+\theta_t)\cos(\theta_i-\theta_t)}
\end{aligned}$$

$$R = r^2 \qquad T = n\frac{\cos\theta_t}{\cos\theta_i}t^2 \qquad \theta_c = \arcsin(n) \qquad \theta_p = \arctan(n) \qquad r = -r' \qquad t't = 1 - r^2$$

Beyond critical angle:

$$\begin{aligned}
\text{TE: } r_\perp &= \frac{\cos\theta - i\sqrt{\sin^2\theta - n^2}}{\cos\theta + i\sqrt{\sin^2\theta - n^2}} \\
\text{TM: } r_\parallel &= \frac{n^2\cos\theta - i\sqrt{\sin^2\theta - n^2}}{n^2\cos\theta + i\sqrt{\sin^2\theta - n^2}} \\
\varphi_{\text{TE}} &= 2\tan^{-1}\left(\frac{\sqrt{sin^2\theta - n^2}}{\cos\theta}\right) \text{ for } \theta > \theta_c \\
\varphi_{\text{TM}} &= 2\tan^{-1}\left(\frac{\sqrt{\sin^2\theta - n^2}}{n^2\cos\theta}\right) \text{ for } \theta > \theta_c
\end{aligned}$$

$$I_r = I_0\frac{4r^2}{(1+r^2)^2} \qquad I_t = I_0\frac{1}{1 + F\sin^2(\delta/2)} \qquad F \equiv \frac{4r^2}{(1-r^2)^2} \qquad \delta = 4\pi\frac{\ell}{\lambda}\frac{n_t}{\sqrt{1 - (n/n_t)^2\sin^2\theta_i}}$$

$$E = E_0 e^{-x/\alpha} \text{ with } \alpha = \frac{\lambda}{2\pi\sqrt{\sin^2\theta/n^2 - 1}} \qquad \sigma \ll \omega\epsilon\text{: } \alpha = \frac{1}{\sigma}\sqrt{\frac{\epsilon}{\mu}} \qquad \sigma \gg \omega\epsilon\text{: } \alpha = \frac{1}{2\sqrt{2\sigma\mu\omega}}$$

$$\text{LHC: } \frac{1}{\sqrt{2}}\begin{bmatrix} 1 \\ i \end{bmatrix} \qquad \text{RHC: } \frac{1}{\sqrt{2}}\begin{bmatrix} 1 \\ -i \end{bmatrix} \qquad \text{QWP, SA horizontal: } \begin{bmatrix} 1 & 0 \\ 0 & -i \end{bmatrix}$$

$$\text{Linear polarizer, TA } \theta\text{: } \begin{bmatrix} \cos^2\theta & \sin\theta\cos\theta \\ \sin\theta\cos\theta & \sin^2\theta \end{bmatrix}$$