

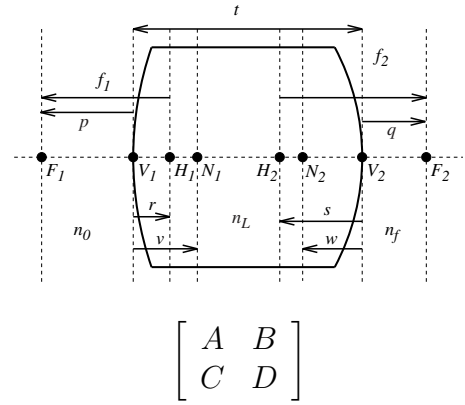
Equation sheet for PHY 300 exam 2 as of April 14, 2006. It's possible I might add one or two things more to this; if so, I'll send e-mail. You will be given this sheet in class.

+R is with center of curvature "downstream"

$$\frac{n_1}{s_1} + \frac{n_2}{s'_1} = \frac{n_2 - n_1}{R_1} \quad \frac{1}{f} = \frac{n_2 - n_1}{n_1} \left(\frac{1}{R_1} - \frac{1}{R_2} \right) \quad \frac{1}{s} + \frac{1}{s'} = \frac{1}{f} \quad \frac{1}{f} = \frac{2}{R} \quad m = -\frac{n_1 s'}{n_2 s}$$

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

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



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

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

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

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

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

Beyond critical angle:

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

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

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

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

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