PHYS 100C, Homework #2, due Monday, April 19 before class.

Problem 9.13 Calculate the *exact* reflection and transmission coefficients, *without* assuming $\mu_1 = \mu_2 = \mu_0$. Confirm that $R + T = 1$.

Problem 9.14 In writing Eqs. 9.76 and 9.77, I tacitly assumed that the reflected and transmitted waves have the same *polarization* as the incident wave—along the x direction. Prove that this *must* be so. [*Hint:* Let the polarization vectors of the transmitted and reflected waves be

$$\hat{\mathbf{n}}_T = \cos\theta_T\,\hat{\mathbf{x}} + \sin\theta_T\,\hat{\mathbf{y}}, \quad \hat{\mathbf{n}}_R = \cos\theta_R\,\hat{\mathbf{x}} + \sin\theta_R\,\hat{\mathbf{y}},$$

and prove from the boundary conditions that $\theta_T = \theta_R = 0$.]

*** Hint for 9.14:look at y-components of boundary conditions for E, and compare to equation for x-components of boundary conditions for B.**

Problem 9.15 Suppose $Ae^{iax} + Be^{ibx} = Ce^{icx}$, for some nonzero constants A, B, C, a, b, c, and for all x. Prove that $a = b = c$ and $A + B = C$.

*** Hint for 9.15: Differentiate.**

! **Problem 9.16** Analyze the case of polarization *perpendicular* to the plane of incidence (i.e. electric fields in the y direction, in Fig. 9.15). Impose the boundary conditions 9.101, and obtain the Fresnel equations for $\tilde{E}_{0_R}$ and $\tilde{E}_{0_T}$. Sketch $(\tilde{E}_{0_R}/\tilde{E}_{0_I})$ and $(\tilde{E}_{0_T}/\tilde{E}_{0_I})$ as functions of θ_I, for the case $\beta = n_2/n_1 = 1.5$. (Note that for this β the reflected wave is *always* 180° out of phase.) Show that there is no Brewster's angle for *any* n_1 and n_2: $\tilde{E}_{0_R}$ is *never* zero (unless, of course, $n_1 = n_2$ and $\mu_1 = \mu_2$, in which case the two media are optically indistinguishable). Confirm that your Fresnel equations reduce to the proper forms at normal incidence. Compute the reflection and transmission coefficients, and check that they add up to 1.

*** Hint for 9.16 – Maxwell Eq. (i) does not yield anything useful, and (ii) and (iii) turn out to be equivalent, once you take into account Snell's law. Keep careful track of signs.**