Physics 470 **Homework 8** **Due Wednesday, November 8, 2017**

Reading assignment: Griffiths section 9.4.

Problem 1. Review and understand the midterm solutions.

Problem 2. Light is incident on glass from air. Assume that $\mu_{\text{glass}} = \mu_{\text{air}} = \mu_0$, and that the index of refraction of this particular type of glass is $n = 1.65$, and that of air is very nearly $n = 1.00$.

(a) Make a graph of the ratios of amplitudes $\widetilde{E}_{0T}/\widetilde{E}_{0I}$ and $\widetilde{E}_{0R}/\widetilde{E}_{0I}$ as functions of the angle of incidence, similar to Figure 9.16 on page 391 in Griffiths, assuming that the light is polarized parallel to the plane of incidence. Include enough points on your graph so that the shape is clear. (You are encouraged to use a computer or calculator.)

(b) Make another graph of the reflection and transmission coefficients R and T, again assuming that the light is polarized parallel to the plane of incidence.

(c) Estimate Brewster's angle (if there is one), and the incident angle at which R and T are equal, from your graph.

(d), (e), (f) Do the same for the case of light polarized perpendicular to the plane of incidence.

Problem 3. Redo Problem 2, but now for the case of light incident on air, from glass. Be sure to account for the phenomenon of total internal reflection when planning your graphs.

Problem 4. (a) Show that the skin depth in a poor conductor ($\sigma \ll \epsilon\omega$) is $d = (2/\sigma)\sqrt{\epsilon/\mu}$, independent of frequency.

(b) In class, we showed that the skin depth in a good conductor ($\sigma \gg \epsilon\omega$) is $d = \sqrt{\dfrac{2}{\omega\sigma\mu_0}}$. [Note: this is equal to $1/k = \lambda/2\pi$, where λ is the wavelength in the conductor.] Find the skin depth in meters for a "typical metal" ($\sigma \approx 2 \times 10^7\,\Omega^{-1}m^{-1}$ and assuming $\epsilon \approx \epsilon_0$ and $\mu \approx \mu_0$) in the visible range ($\omega \approx 10^{15}/s$). Why are metals opaque?