Physics 302/572: Electromagnetic Theory II

Read: Griffiths 9.2, 9.3

"**G**, **PS**" refer to Griffiths and Pollack & Stump books respectively.
Problems with stars are not for credit and will NOT be graded.

Homework 3

Exercise 1 (G 9.10)

The intensity of sunlight hitting the earth is about 1300 W/m^2. If sunlight strikes a perfect absorber, what pressure does it exert? How about a perfect reflector? What fraction of atmospheric pressure does this amount to?

Exercise 2 (G 9.12)

Find all elements of the Maxwell stress tensor for a monochromatic plane wave traveling in the z direction and linearly polarized in the x direction. Does your answer make sense? (Remember that $\overleftrightarrow{T}$ represents the momentum flux density.) How is the momentum flux density related to the energy density, in this case?

Exercise 3 (PS 13.5)

Consider light traveling from $x = -\infty$, incident normally on a plate of glass with thickness a. The plate is parallel to the yz plane, with one face at $x = 0$ and the other at $x = a$. The index of refraction is $n_0 = 1$ for $x < 0$ and $x > a$, and $n = 1.5$ for $0 \leq x \leq a$. The electromagnetic field in the region $x < 0$ is a superposition of right and left traveling waves (where right means $\hat{x}$ and left means $-\hat{x}$), which are the incident and reflected waves. In the region $0 \leq x \leq a$ there are both right and left traveling waves, and in the region $x > a$ there is only the transmitted right traveling wave.

a) Write $\vec{E}(x,t)$ and $\vec{B}(x,t)$ in the three regions, letting $\hat{y}$ be the polarization direction. Write the four boundary conditions on the wave amplitudes.

b) Solve for the transmission coefficient T, i.e., the ration of transmitted intensity to incident intensity.

c) Plot T as a function of ka, where k is the incident wave vector.