Physics 514, Winter Quarter 2018
Electrodynamics: Homework Assignment 9
Due March 9, either 11:00am in class or 10:45am in the instructor's mailbox.
This is an exam-review homework.
Note only 2 problems will be graded.

1. (graded problem) Show that in a good conductor the skin depth is $\lambda/2\pi$ where λ is the wavelength in the conductor. Show that in a poor conductor the skin depth is $\frac{2}{\sigma}\sqrt{\varepsilon/\mu}$.

2. The conductivity of air containing mobile electrons is given very approximately by $\sigma = -i(Ne^2/\omega m)$ where *e* is the electron charge and *m* its mass. Find the resulting propagation velocity and hence the index of refraction *n*. This is related to radio waves bouncing off the ionosphere.

3. (graded problem) Consider a plane wave in a poor lossless conductor incident in the normal direction on a plane conducting surface. Show that the transmitted and reflected amplitudes are the same as those in the non-conducting case except the index of refraction in the conductor is now complex. That is, show in the conductor that the amplitudes are $E_{0r} = \left(\frac{1-z}{1+z}\right)E_{0i}$ and $E_{0t} = \left(\frac{2}{1+z}\right)E_{0i}$ with $z=n_0/n_c$ (where n_0 is the index of refraction in the poor conductor, n_c the complex index of refraction in the conductor, and μ in both is μ_0).

4. A waveguide consists of two almost-infinite parallel conducting sheets separated by a gap *L*. A plane wave having free-space wavelength λ_0 enters the guide at an angle θ_0 relative to the normal to the sheet. Find the guide phase velocity and wavelength.

[ver 06mar18 12:30]