Physics 514, Winter Quarter 2018
Electrodynamics: Homework Assignment 3
Due Jan. 26, 5:00pm either 11:00am in class or 10:45am in the instructor's mailbox.

1. Consider an oscillating point electric dipole $\mathbf{P}e^{-i\omega t}$. Find the corresponding electric Hertz vector $\Pi_e(\mathbf{r},\omega)$ and thereby find the electric and magnetic fields. We'll do this later as "infinitesimal electric dipole antenna" radiation.

2. Recall last quarter we found a "relaxation time" of a medium ε/σ. Show that if the relaxation time is long compared to the wave oscillation time, then the wave propagates. What sort of phenomenon occurs at the other extreme of short relaxation times?

3. Consider a cavity with completely absorptive walls. The cavity contains homogeneous isotropic radiation with amplitude E (the radiation is unpolarized and of equal intensity in all directions). Find the normal pressure on the cavity walls. This has obvious connections to black-bodies in thermodynamics.

4. Dirac's decomposition. A volume contains plane waves propagating in vacuum. Show the total angular momentum in the volume is $\iiint \epsilon_0 E_i(\mathbf{r}\times\nabla)\, A_i \, dv + \iiint \epsilon_0 \mathbf{E}\times\mathbf{A}\, dv$. Because the second term is "local" (doesn't contain r), there was a temptation to treat it as the intrinsic spin of the electromagnetic wave, but this interpretation has a number of problems.

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