Physics 110B. Electricity and Magnetism. Professor Dine

Spring, 2008. Homework Set 5. Due Thursday, May 28.

Please deposit in box in Physics office as we will not have class that day

Warning: The Next Homework Will Follow Quickly After this One

Problem numbers refer to your textbook.

1. 11.3

2. In class, we showed that for a localized, steady distribution of currents,

$$\vec{A} = \frac{\mu_o}{4\pi}\frac{\vec{m}\times\vec{x}}{x^3}. \tag{1}$$

Here the magnetic dipole moment is:

$$\vec{m} = \frac{1}{2}\int d^3x'\vec{x}'\times\vec{J}(\vec{x}'). \tag{2}$$

a. Compute the magnetic dipole moment for a current loop of radius b carrying a current I. Then compute the dipole moment for a charged particle of charge q, located at $\vec{x}(t)$, moving with velocity $\vec{v}(t)$. Express your result in terms of the particle's angular momentum.

b. For the case of radiation due to localized currents, we saw that the vector potential was given by:

$$\vec{A}(\vec{x},t) = \frac{\mu_o}{4\pi rc}\hat{r}\times\frac{d}{dt}\vec{m}(t_{ret}). \tag{3}$$

Compute the electric and magnetic fields, and show that for a current loop, as in your text or lecture, this expression gives the same results. Compute also the Poynting vector.

3. 11.22

4. 11.25