

# CLASSICAL ELECTRODYNAMICS II

## Homework Set 7

October 31, 2014

1. A thin linear antenna of length  $d$  is excited in such a way that the sinusoidal current makes a full wavelength of oscillation. That is, the current through the antenna can be written as

$$I = I_0 \sin \frac{2\pi z}{d} e^{-i\omega t} ,$$

where  $I_0$  is a constant and  $\omega = kc = 2\pi c/d$ .

- (a) Determine the corresponding current density  $\mathbf{J}(\mathbf{r}, t)$ .
- (b) Calculate the electric dipole moment. Does this antenna emit electric dipole radiation? If so, at what frequency or frequencies?
- (c) Calculate *exactly* the vector potential  $\mathbf{A}(\mathbf{r}, t)$  in the radiation zone.
- (d) Use your result from part (c) to calculate the magnetic field  $\mathbf{H}(\mathbf{r}, t)$  and the electric field  $\mathbf{E}(\mathbf{r}, t)$  in the radiation zone.
- (e) Use your results from part (d) to calculate the power radiated per unit solid angle, and sketch the angular distribution of radiation emitted.