Physics 323, Spring Quarter 2016
Electrodynamics: Homework Assignment 4
(a) Turn in all problems and clearly note all constants and assumptions you use. (1-point penalty each otherwise)
(b) Use 8½ x 11 paper & staple (1-point penalty each otherwise)
(c) Due April 28 either 9:00 am in class or 8:45 am in the instructor's mailbox; late homework gets 0.

1. A point charge q is in uniform motion $V\hat{z}$ with the velocity V constant. At time t=0 the charge is located at the origin. At a later time t' at a field point $x=x_0$, y=z=0:
a. Find the scalar and vector potential.
b. What coordinate components does the electric field have?
c. What coordinate components does the magnetic field have?
d. Find the component E_x.

2. RG-6/U cable is a type of TEM coaxial waveguide commonly used in cable TV from DC to around 900 MHz, the upper end of the UHF TV band. Approximately, the inner-conductor diameter is 1mm, the outer-conductor diameter is 7mm, and the space between conductors is filled with solid polyethylene dielectric. (NB. sometimes the polyethylene is a foam; ignore that detail).
a. Estimate the propagation velocity (phase velocity) of TEM waves along this cable. Estimate the guided wavelength in this cable. You'll need to look up properties of the dielectric.
b. Suppose you don't want any reflections from the end of the cable. What value of termination resistor do you need?
c. Suppose you left the termination resistor off and you're interested in cable TV channel 48 (KING TV, frequency band around 370 MHz). At what positions from the open end of the cable are the voltage

maxima and minima? At what positions are current maxima and minima?

3. Yet again consider a spherical capacitor of inner radius r_I and outer radius r_O with a slightly conducting dielectric of resistance R. At t=0 there's charge +Q on the inner plate, and –Q on the outer plate, and the capacitor self-discharges slowly through the dielectric.
a. For t > 0 find the current from inner to outer plate.
b. For t > 0 find the voltage across inner and outer plates.
c. Use the Lorentz condition (Griffiths equation 10.12) to find the vector potential.
d. Use the potential in (c) to find the magnetic field.

4. ** 4. Consider the retarded-time charge density $\rho(\mathbf{r}',t_r)$ appearing in the retarded potential Griffiths 10.26. Does the volume integral $\iiint \rho(\mathbf{r}',t_r)d^3x$ represent the total charge of the system? If not, explain why.

** Challenge problem

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