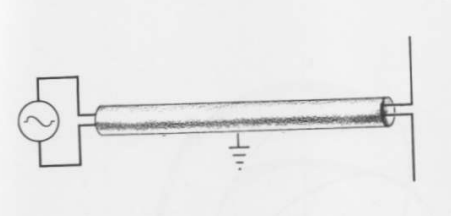
Electrodynamics III: Assignment 2
Due April 17 at 11:00 am.

1. **Scan your solutions as a single PDF file**
2. **Name your file HW2-*lastname*.pdf**
3. **Attach your file to an email…**
4. **… with subject line HW2-*lastname* …**
5. **… and send the email to ljrosenberg@phys.washington.edu**

1. The magnetic dipole. The infinitesimal magnetic dipole consists of a conducting circular loop of wire of radius R in the z=0 plane where a source supplies harmonic current $\boldsymbol{I_\omega e^{i\omega t}}$ around the wire. Infinitesimal means $R<<\lambda_0$, the free-space radiation wavelength. From the result of the infinitesimal electric dipole and duality, we found the radiation fields (and other properties) of the magnetic dipole Find the infinitesimal magnetic dipole fields from direct integration of the current in the retarded potential. This is done is several texts.

2. Consider the "biconical" antenna from lecture. A harmonic current source provides current $I(t)$ into and out of the antenna terminals, and a resulting voltage $V(t)$ appears across the antenna terminals. Show that the time-average total radiated power agrees with the expectations of circuit theory for a current source $I(t)$ across a voltage $V(t)$.

3. Fun problem, not graded. From a figure in a book on electrodynamics, here's a system consisting of an electric dipole, a grounded coaxial TEM transmission line and a source. There's a problem with this system as shown, it won't function properly as an electric dipole radiator. Can you identify the problem and suggest a practical way to fix it?



4. Spherical resonator. In lecture we discussed the spherical resonator of radius R. This was an exercise in solving the wave equation in spherical coordinates. In particular, we found the resonant frequency of the lowest TM mode (the TM_{010} mode). Find the resonant frequency of the lowest TE mode (the TE_{010} mode). Hint: Since you already know the properties of the lowest TM mode, duality leads to the dual TE mode. But you need to pay attention to the appropriate boundary conditions. Also, the frequency is given in the root of a transcendental equation, you'll need to approach this root numerically or graphically.

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