# Physics 106b: Electrodynamics

# Problem Set I

### Due: 4pm, Friday, February 20, 2009

Remember: Late homework will be granted 50% credit up to one week late, unless you have a note from the Dean or a health official. Homework should be turned into the box outside 114 Sloan Annex.

**Reading:** Griffiths Chapter 2
**Problems:**

**1**. Prove $\nabla\times(\mathbf{A}\times\mathbf{B}) = (\mathbf{B}\bullet\nabla)\mathbf{A} - (\mathbf{A}\bullet\nabla)\mathbf{B} + \mathbf{A}(\nabla\bullet\mathbf{B}) - \mathbf{B}(\nabla\bullet\mathbf{A})$ using $\varepsilon_{ijk}$ and the repeated index summation convention. Recall that $\varepsilon_{ijk}\varepsilon_{klm} = \delta_{il}\delta_{jm} - \delta_{im}\delta_{jl}$

**2**. Griffiths 2.33

**3**. Griffiths 2.36

**4**. Griffiths 2.41

**5**. Evaluate numerically (to 3 significant figures), the delta-function integral

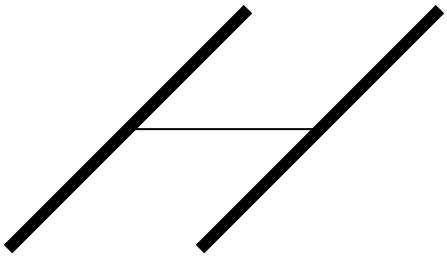
$$\int_0^{\pi} \frac{\delta(J_0(x))}{(x+1)^2}\,dx$$

$J_0(x)$ is the zeroth order ordinary Bessel function. Explain all steps; do not hand in the output of some symbolic math program like *Mathematica*. You may however use tabulated values of $J_0(x)$.

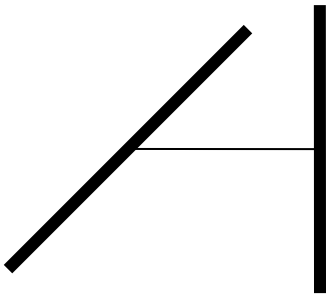
**6**. Consider two thin rods, each of length L. One rod carries a uniform linear charge density λ, while the other is uniformly charged with density λ'. These rods are attached, at their middles, to opposite ends of a third rod of length H. This third rod is uncharged. Assume that the charged rods are both perpendicular to the axis of the shorter rod.
**a)** Calculate the force on each charged rod assuming they are parallel to one another.
**b)** Do the same, but now with the charged rods perpendicular to one another.
(It's helpful to check that your results make sense when H>>L)

**-SEE NEXT PAGE-**

These (poor) diagrams suggest the arrangements



**charged rods parallel**



**charged rods perpendicular**