

Physics 106b: Electrodynamics

Problem Set I

Due: 4pm, February 17, 2012
deposit in box in 149 Bridge Annex

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.

Reading: Griffiths Chapter 2

Problems:

1. Prove $\nabla(\mathbf{A} \cdot \mathbf{B}) = \mathbf{A} \times (\nabla \times \mathbf{B}) + \mathbf{B} \times (\nabla \times \mathbf{A}) + (\mathbf{A} \cdot \nabla)\mathbf{B} + (\mathbf{B} \cdot \nabla)\mathbf{A}$ using ε_{ijk} . It may help to first prove $\varepsilon_{ijk}\varepsilon_{klm} = \delta_{il}\delta_{jm} - \delta_{im}\delta_{jl}$, recalling that repeated indices are summed over.
2. 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 $J_0(x)$ and other Bessel functions.

3. Consider two infinitely long parallel wires, separated by a distance d . One wire carries a uniform charge per unit length of λ , while the other carries $-\lambda$. Show that the equipotentials for this system are circular cylinders. Sketch them.
4. Using the results of problem 3, determine the capacitance per unit length between two infinitely long parallel conducting cylinders, each of radius R , with a center-to-center separation $d = 4R$.