Electrodynamics (PHYS 480) Third Guide

Fall 2014 v1.0

In class we have discussed solving the Laplace equation $\nabla^2 V = 0$ via image charges and separation of variables. We'll be working our way through the multipole expansion before turning to the electric fields in materials that are neither (ideal) conductors nor insulators (all in chapter 4).

There is a very good chance that I will leave early on Friday.

Problems of note: Starred (*) problems are required.

(1) 3.1 An integration with a nice result.

(2) 3.2 Earnshaw's theorem. Don't get caught up by Griffiths "one sentence" request. Justify the result as best you can.

(3) 3.4 You can work from Griffiths' version of the (second) uniqueness theorem or the one I discussed. It should not be lots of work.

(4) 3.9 More image charges in a spherical geometry

(5) 3.18 Note: $P_0(\cos\theta) = 1$

(6) 3.19 Hint: Write $\cos 3\theta$ as a sum of $\cos\theta$ and $\cos^3\theta$ then match this new expression for the potential.

$$\cos 3\theta = 4\cos^3\theta - 3\cos\theta$$

with the general expansion.

Material of note:

- Earnshaw's Theorem: Discuss problem 3.2, offer your favorite proof of the theorem (Maxwell's?). See Weinstock AJP 44 (1976) 526.
- Image charges: Why does this technique work at all? (We start with completely different problems!) Present Example 3.2 and problem 3.9.
- Separation of variables: Introduction (cartesian coordinates)
- Fun facts about Legendre polynominals (as done in Phys 320): This ought to come with a 3-4 page handout. Use information from a diff eq'ns course, Phys 320, Abromowitz and Stegun, Mathematica, Maple ...