Electrodynamics (PHYS 480) Seventh Guide

Fall 2014 v1.0

While the title of Chapter 7 is "Electrodynamics", we do not (yet) see much in the way of full electrodynamics. This comes later in electromagnetic waves, in radiation fields of moving charges, in special relativity, and in the interaction of electric and magnetic fields in matter. Instead Griffiths sneaks up on the final form of the theory in Chapter 7 by introducing several concepts, probably familiar from your earlier courses, such as emf and displacement current. There are several key steps which I mention in the "Notes on text."

When you finish the chapter, read the "Intermission" on the next page.

Problems of note:

(1) 6.8 Working with **J** and **K**
(2) 6.12 Finding **H**.
(3) 6.14 Sketching fields for a magnetized cylinder
(4) 6.15 Recycling methods from chapter 3 on a (scalar) magnetic potential
(5) 6.25 A charming parallel
(6) 7.1 A spherical conductor, For the last part consider ($b >> a$).
(7) 7.2 An opportunity for circuit review
(8) 7.6 After thought, short
(9) 7.7 You have probably done a variation on this before

Notes on text:

- page 296 Ohm's Law - An odd way to start a chapter on dynamics. Why do you suppose that Griffiths does this? Despite this oddity do take careful note of the definitions of σ and ρ. If you did the optional problem earlier, do you see how they fit into the Hall Effect?
- (page 298 BTW does the result of Example 7.2 look familiar?)
- page 300-1 This is a very interesting argument (a nice lead in to the standard derivation of Drude's relation).
- page 303 Notice hand waving (Griffiths is moving rapidly through a very difficult subject here). Despite this, it is worth understanding this in full. You may find his **f** notation confusing. What is meant by the lower case letters is *force per unit charge.*
- page 304 The emf is introduced. Recall or go back to your notes to see how it was introduced in an earlier physics course. How do you show that the two definitions are equivalent? (if there are two, that is).
- pages 307 The first sign of dynamics (i.e. at last, a time derivative!). Work through this nice proof in detail.
- page 312 The emf and Faraday's work leads us to the two useful forms of Faraday's law.
- page 315 It comes with a nice slogan "Nature abhors a change in flux" to help us with a matter of a sign. (Griffiths has taken a famous saying in quantum field theory, "Nature abhors a vacuum" and has given it an electrodynamic twist.)
- page 319 This is key: We assume that nearly all physical processes are slow enough to use magnetostatics.
- page 321 Section 7.2.3 introduces inductance. Note the trick employed in Example 7.10. Check the units of a henry using dimensional analysis (M, L, T, Q).
- pages 328 The discussion of the energy in magnetic fields is quite nice, particularly when it comes to work and the role of the electric field. Understand this.
- page 333 A cute "Maxwell-demonesque" argument - well worth pondering for a while.

- page 334 Don't let this short argument go by without you fully understanding it. For instance, where did the continuity equation come from? How did we derive it in the first week? Is this argument circular? (Editorial: This section ought to be called "How Griffiths Fixed Ampere's Law.)
- page 337 and 341 MAXWELL'S EQUATIONS!! The rest of the chapter is a discussion of the overall structure of these equations.
- page 342-4 Pay close attention to the boundary conditions. We'll use them lots.

And more Cool stuff:

- **Have you all seen this??** Thomson's Jumping Ring: The demo and the effect. (One derivation is in Saslow's article on page 990 of *Am. J. Phys.* 11 (1987).)
- Displacement Current : Working through the calculation of the displacement current in a charging capacitor (Prob. 7.35). Read about the experiment in which the **B** was measured in *Phys. Rev. Lett.* **55** (1985) 59.
- Meissner Effect: Problems 7.44, 7.45 With demo?
- The famous Valentine's Day experiment: Work through problem 7.39 and give a summary of B. Cabrera *Phys. Rev. Lett.* **48** (1982) 1378.