Study Questions for Darrigol (2000) *Electrodynamics from Ampère to Einstein*.

Chapter 1

1. What was the goal of Laplace and his followers?
2. According to Coulomb's two fluid theory of magnetism, why are there no magnetic monopoles?
3. What were some reasons why electricity and magnetism were considered different phenomena before the 1820s?
4. What were Oersted's claims about the "electric conflict" associated with a galvanic source?
5. According to Ampère, to what does every magnet owe its properties of attraction?
6. What was Ampère's general principle concerning currents flowing in wires of different shapes?
7. How does Darrigol characterize Ampère's experiments? Was was the view of Ampère's contemporaries concerning the quality of his experiments?
8. What was Biot's criticism of Ampère's force law?
9. What was Faraday's basic observation in his experiments with a vertical wire and a suspended magnetic needle?
10. According to Faraday, what is a "pole"? What does the term "power" refer to?
11. According to Darrigol, what were some differences between Faraday and Ampère?
12. Why did Ampère object to Faraday's "primitive rotations"?
13. What did Ampère's term "electro-dynamique" refer to?
14. According to Ampère's force law, what is the relation between the forced impressed on a current element by a closed circuit, and the direction of the element?
15. Did Ampère think his force law made any assumptions about the nature of electric currents?
16. What did Ampère's demonstration that a closed circuit and a net of infinitesmial current loops are equivalent suggest about the ether?
17. According to Darrigol, what might Faraday have reasoned, given that the current-carrying state of a conductor implied magnetic power?
18. Faraday observed that the conversion of magnetism into electricity didn't occur for steady currents. Instead, under what circumstances did he initially observe it?
19. What was Faraday's "electro-tonic" state?
20. What was Faraday's 1832 statement of the law that summarized his experimental observations?

Chapter 3.

1. How does Darrigol use the term "field"?
2. What was the role of Faraday's wet string?
3. What was Faraday's law of electrolysis?
4. How did Faraday describe the current associated with electrolytic decomposition?
5. According to Faraday, how was an insulator in the presence of an electric source similar to an electrolyte before decomposition? What characterizes the insulator?
6. According to Faraday, does electric charge belong to an insulator or to a conductor?
7. What did Faraday mean by his claim that there is no absolute charge? How does a "Faraday cage" support this claim?
8. How did Faraday test the dependency of induced charges on the nature of the dielectric?
9. Why did Faraday think that induction can occur in "curved lines"? Why did he think this was evidence against action-at-a-distance theories?
10. According to Faraday's view on induction, what was an electric charge? What was an electric current?
11. What are "lines of electric induction"? Did Faraday think they really existed?
12. How did Faraday's contemporaries misunderstand his claim about absolute charges? His claim about induction in curved lines? His views about the physical way induction occurs?
13. What did Faraday observe in 1845 when he subjected polarized light to a magnetic field?
14. How did Faraday initially use the phrase "magnetic field"?
15. According to Faraday, how do lines of magnetic force determine how material bodies behave?
16. What was the analogy between electrostatics and heat flow that Thomson adopted?
17. According to Thomson, what does the "electrostatic pontential" V represent?
18. What is "mechanical effect"? What is an "absolute measurement"?
19. What was Thomson's "Law of Squares"?
20. What was Thomson's analogy between Faraday's concepts of electric and magnetic forces and Stokes' description of viscous fluids?
21. What aspects of Rankine's description of heat did Thomson adopt in his description of electromagnetism?

Chapter 4.

1. How does Maxwell define a line of force?
2. How did Maxwell formulate his "Law #1" (Faraday's Law)?
3. How did Maxwell formulate his "Law #2" ("Ampere's circuit Law)?
4. In "On Faraday's Lines of Force", what role is played by Maxwell's imaginary incompressible fluid?
5. According to Faraday, what is "electric intensity"? What is "electric quantity"?
6. What was Maxwell's geometric interpretation of intensity and quantity?
7. What role did the "electro-tonic intensity" play in Maxwell's formulation of Faraday's Law?
8. In "On Physical Lines of Force", what was the significance of fluid vortices?
9. What role did idle wheels play in Maxwell's vortex model?
10. Why couldn't Maxwell's vortex model be initially extended to describe electrostatics?
11. How did the concept of "displacement" solve the problem in #10 above? What actually gets displaced in Maxwell's vortex model?
12. Did Maxwell believe in the literal truth of his vortex model?
13. What role did Maxwell's "electromagnetic momentum" **A** play in his desire to reformulate his theory without any specific mechanism?
14. In "Dynamical Theory of the Electromagnetic Field", how did Maxwell define electric current? How was this different from the definition of electric current in his vortex model?
15. In "Dynamical Theory of the Electromagnetic Field", what is "displacement"?
16. In Maxwell's 1873 *Treatise*, what is polarization? What is electric charge? What is electric current?
17. What did Maxwell mean by the polarization of a piece of dielectric is a displacement of electricity?
18. What did Maxwell mean when he said "the motions of electricyt are like those of an incompressible fluid"?
19. In the *Treatise*, what is "force"? What is "flux"?
20. Why did Maxwell refuse to eliminate the potential terms in his equations?
21. In what sense is the core of the *Treatise* essentially macroscopic?