1. Consider a harmonic voltage source attached to a vacuum capacitor (as shown in the figure), which leads to a current given by $I = I_0 exp[i\omega t]$. This problem is designed to demonstrate the complicated effects of Maxwell's contribution to Ampere's law. We will show that this effect is small for audio frequencies in a typical capacitor. Most textbooks do not broach the subject, for fear of confusing students.
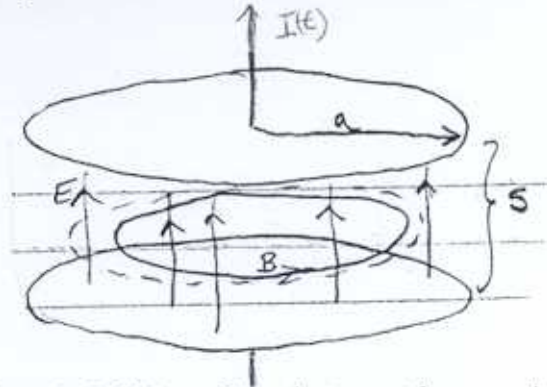
(a) Assume as a first approximation that the electric field is uniform between the capacitor plates. Call this field $E_1 = E_0 exp[i\omega t]$ (note no spatial dependance). Find an expression for the magnetic field using the new version of Ampere's law. This will be our first approximation for the magnetic field so label it B_1.

(b) Now a changing magnetic field causes an electric field. Use Faraday's law along the path shown to determine the first correction to the assumption that the electric field is uniform. That is, find E_2. From symmetry we assume that the net electric field at $r = 0$ is just the uniform field of part (a).

SIDE VIEW
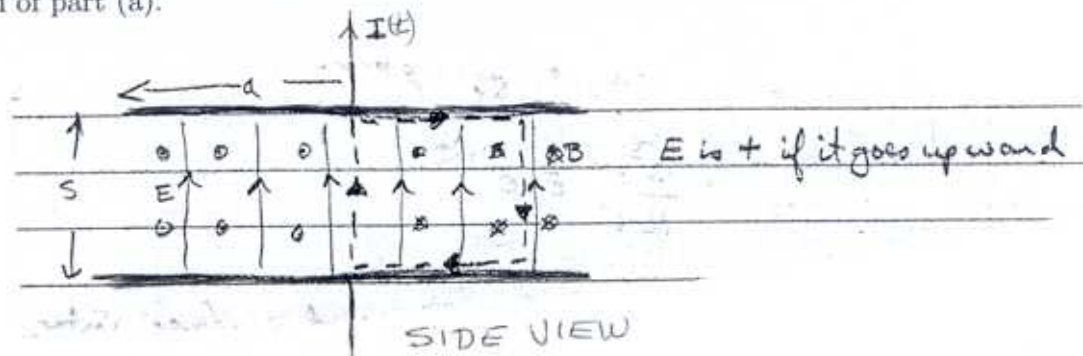
(c) Now the magnetic field we calculated isn't right because it was derived using only E_1. Go back to the initial figure and calculate B_2 just caused by E_2 .

(d) This B_2 causes an E_3 using the argument in part (b). Calculate E_3.

(e) Compile your results as the expansion $E = E_1 + E_2 + E_3 + \ldots$ and $B = B_1 + B_2 + \ldots$. At what frequencies do these terms play an important role?

3. A charge Q moves at speed V parallel to a current carrying wire but a distance D away from the wire. From the discussion in class, show that in the frame of Q the force on Q force has the same dependence on V, D that you would expect from the Lorentz force.

4. A charge Q moves at speed V perpendicular to a current carrying wire and is at a distance D away from the wire. From the discussion in class, sketch a free body diagram, in the frame of Q, to show that the result is what you

would expect from the Lorentz force. This is a qualitative problem.

    5. Chapter 7 problems 7, 26, 29

    6. Watch two videos on Youtube. To find these search youtube for "HAARP at work?" and then "HAARP Nature Modification Weapon! Project Blue Beam." Write a paragraph or two on what is convincing and what is not convincing about the argument in the second video.