9th Homework

Due December 18, 2009

1. Starting from the Maxwell's equations and without using the vector potential, derive the wave-equations for the electric and magnetic fields. How are these equations modified in the presence of charge and current?

2. In a given reference frame, consider a point charge moving at a constant velocity $\vec{v}$ much smaller than the speed of light. Since its speed is much smaller than the speed of light, the retardation effects can be ignored and the electric field can be approximated as a spherically symmetric field that moves with the same velocity. For an observer at rest, there is a time dependent electric field. According to Maxwell's equations, a time dependent electric field induces a magnetic field. Calculate the induced magnetic field.

3. Consider an infinite straight wire with a time dependent current running through it. What is the induced electric field at a given point in space? (Note that stated in this form, there is not enough information in the problem. What other information is needed? What does this information correspond to? Make a reasonable assumption of the missing information and solve the problem accordingly.)