Physics 611, Fall 2014

Problem set #1 (due September 15)

1. Given the three-vector potential $\vec{A}$ with $\nabla \cdot \vec{A} \neq 0$, find a gauge function i *($\vec{r}$)* such that upon performing a gauge transformation to a new vector potential $\vec{A}'$, $\nabla \cdot \vec{A}' = 0$. Give a formula for i *($\vec{r}$)* in terms of $\vec{A}$ *($\vec{r}$).*
2. Starting from the wave equation for the electric and magnetic fields Eqs (6.49) and (6.50), derive their solutions for a point charge, given by Eqs. (6.58) and (6.59)
3. A point charge *q* oscillates around the origin. Its position is given by $z(t)=z_0 \sin$ µt. Find:
   a. The charge density ° and the current density $\vec{J}$ of the system.
   b. The electric and magnetic fields along the *z* and *x* axes (assume that $d >> z_0$ where d is the distance from the observer to the origin);
   c. The total power radiated as a function of time. Compare this last number to the Lamoure formula that gives $P = \frac{2}{3} \frac{q^2}{4®£_0} \frac{a^2}{c^3}$
4. Jackson 6.8
5. Determine the force exhorted on a wall from which the plane electromagnetic wave is reflected (with reflection coefficient *R*). Assume that the angle of incidence is θ.
6. Jackson 6.15