Physics 106c: Electrodynamics

Problem Set 7 - The Last!

Due: 4pm Friday, May June 1, 2012

Remember: Late homework will be granted 50% credit up to one week late, unless you have a note from the Dean or a health official.
Reading: Griffiths Chapter 10 & 11
Problems:

1. Griffiths 10.13

2. Griffiths 11.11

3. A linearly polarized plane electromagnetic wave of frequency ω, propagating along the z–axis with an electric field of amplitude E_0 polarized along the x–axis, falls upon a point charge q of mass m, originally sitting at the origin of coordinates. The point charge is free to move in response to the electromagnetic wave.

a) Solve for the motion of the charge, assuming that its velocity remains very small compared to that of light.

b) The moving charge radiates its own electromagnetic waves. Find magnitude and angular dependence of the time-averaged outgoing power, in terms of E_0, q, m, and ω. Be clear about any angles you need to define.

c) The total scattering cross-section is defined to be that area σ over which the total power in the *incoming* electromagnetic wave equals the total power (integrated over all solid angle) radiated by the point charge. Find a formula for σ appropriate to the preceding discussion

4. A mass m carrying charge q is dropped from a height h. It falls under the influence of gravity and bounces back up. (The bounce is purely elastic.)

a) Determine the difference Δh in the height reached after the first bounce and the original height from which the mass was dropped. Assume that the difference $\Delta h << h$ and that the only way energy is lost is via dipole radiation. You may assume that the ground off which the mass bounces does not affect the radiation at all.

b) Suppose instead the mass bounces off a perfectly conducting metal. How does the height difference Δh in this case differ quantitatively from that in part a)? You must justify your answer.