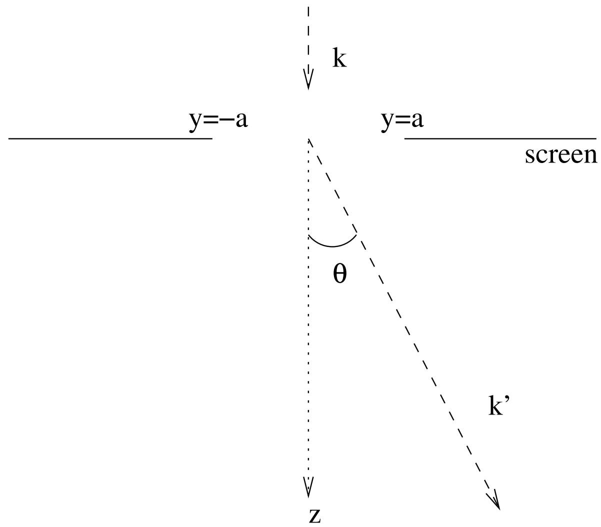

Figure 1: Diffraction slit configuration viewed in the y-z plane. The $\hat{x}$ direction is into the page. The wave vectors k (incident) and k' (final) have same magnitudes but just different directions as shown.

Physics 721 Homework 14
Assigned: Mon. 4/25/05
Due: Mon. 5/2/05 (hard deadline)

1. A nonrelativistic electron of mass m and charge $-e$ is moving in a constant magnetic field $\vec{B} = B\hat{z}$. The electron motion is governed by electromagnetic wave incident on it (in addition to the constant $\vec{B}$ field).

a) Find the electron motion driven by the field of a cirularly polarized electromagnetic wave with amplitude E_0 and frequency w propagating along the $\hat{z}$ direction:

$$\vec{E} = E_0 \hat{\epsilon}_{\pm} e^{ikz-iwt}$$

Consider both left and right polarization cases and neglect radiation damping. (Hint: Recall the Lorentz force law and try $\vec{x} = r_0 \hat{\epsilon}_{\pm} e^{-iwt}$ as a solution and determine r_0 for left and right circular polarization cases.)

b) Find the differential and total scattering cross section for the *left* circularly polarized light from an electron immersed in a $\vec{B}$ field from the result of part a). (Hint: Solve for the dipole moment $\vec{p} = \int \vec{y}\rho(\vec{y})d^3y$. Remember to sum over the 2 independent final polarization states.)

2. Suppose a monochromatic linearly polarized ($\vec{E}$ in the $\hat{y}$ direction) is incident upon a perfect conductor screen with an infinite straight slit as shown in Figure 1 (the width of slit is a). Compute the intensity $I(\theta)$ of the diffracted light *far away* from the screen as a function of θ. Express your answer in terms of the radiation intensity at $\theta = 0$ defined as $I_0 \equiv I(\theta = 0)$.