PHY3323: ELECTROMAGNETISM I

Problem set 9, (due Nov. 5, 2008)

PROBLEM 1 (30 points)

A cube of side a, (Figure 1), is made of dielectric material and has a uniform polarization:

$$\vec{P} = k\hat{z}$$

(a) Find the bound surface charge on each side, the bound volume charge and the total charge of the cube.

(b) Find the dipole moment of the cube.

(c) Find an approximate expression for the potential of the electric field, that is resulting from the polarization, in the region far from the cube ($r >> a$).

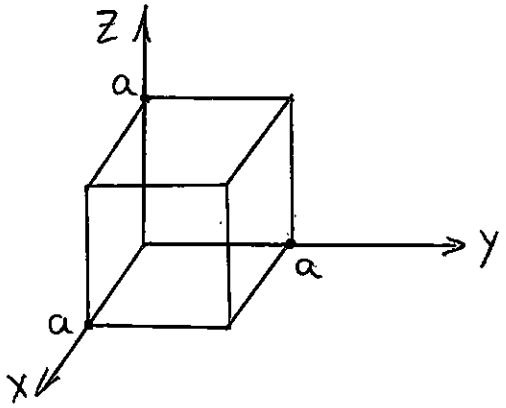

Fig. 1

PROBLEM 2 (30 points)

A spherical conductor of radius a carries a charge Q (Figure 2). It is surrounded by linear dielectric material of susceptibility χ_e, out to radius b.

(a) Find the potential of the field in all three regions (with respect to a point in infinity): (i) r<a, (ii) a<r<b, (iii) r>b.

(b) Find the electric field in all three regions: (i) r<a, (ii) a<r<b, (iii) r>b.

(c) Calculate the energy of the system.

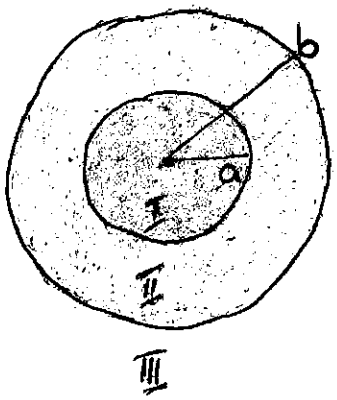

Fig. 2