准帶項目請打「V」

	簡單型計算機

本試題共　1　頁，4　大題

※　請詳細列出各步驟及計算過程,否則不予計分.
※　每題 25 分.

1. A metal sphere of radius a carries a charge Q. It is surrounded, out to radius b, by a linear dielectric material of permittivity ε.
    (a) Find electric field, $\vec{E}$ and displacement, $\vec{D}$ in the three regions $r < a$, $a < r < b$, and $r > b$. Graph $E(r)$ and $D(r)$.
    (b) Find the potential at the center (relative to infinity).
    (c) Compute the polarization in the dielectric.

2. At the interface (in x-y plane) between one linear dielectric of permittivity ε_1 and another of ε_2, the electric field lines bend as shown in Fig. 1.
    (a) Derive the boundary conditions.
    (b) Show that $\tan\theta_2 / \tan\theta_1 = \varepsilon_2 / \varepsilon_1$, in the case there is no free charge at the boundary.

3. A small loop of wire (radius a) lies a distance z above the center of a large loop (radius b, in the x-y plane), as shown in Fig.2. The planes of the two loops are parallel, and perpendicular to the common axis.
    (a) Suppose current I flows counterclockwise in the big loop. Find the magnetic field and flux through the little loop. (The little loop is so small that you may consider the field of the big loop to be essentially constant.)
    (b) Suppose current I flows in the little loop. Find the magnetic dipole moment of the loop.
    (c) Find the mutual inductances.

4. A long solenoid with radius a and n turns per unit length carries a time-dependent current $I(t) = I_0 \cos\omega t$ in the $\hat{\phi}$ direction. (In the quasistatic approximation.)
    (a) Find the magnetic field inside and outside the cylinder.
    (b) Find the electric field (magnitude and direction) at a distance s from the axis (both inside and outside the solenoid).
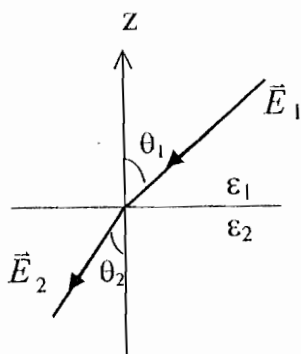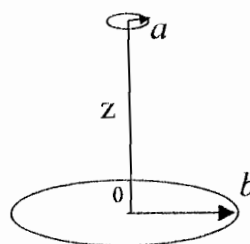

Fig.1

Fig.2