1. A charge q sits at the back corner of a cube, as shown in Fig. 1. What is the flux of **E** through the shaded side? (10%)
2. Suppose a point charge q is held a distance d above an infinite grounded conducting plane, Fig. 2. What is the potential in the region above the plane? Prove that the answer is unique? (15%)
3. A dipole **p** is a distance r from a point charge q, and oriented so that **p** makes an angle θ with the vector **r** from q to **p**. What is the force on the dipole **p**? Calculated by using the field produced by the point charge q. (10%)
4. A sphere, radius R, of homogeneous linear dielectric material is placed in an otherwise uniform electric field $\mathbf{E}_0$ in $\hat{z}$ direction. Find the electric field inside the sphere. (15%) Hint: In the case of azimuthal symmetry, the most general separable solution to Laplace's equation is $V(r,\vartheta) = \sum_{l=0}^{\infty}(A_l r^l + \frac{B_l}{r^{l+1}})P_l(\cos\vartheta)$, where $P_l(\cos\vartheta)$ are Legendre polynomias and satisfy the orthogonal relations:
$$\int_0^{\pi} p_l(\cos\vartheta)p_{l'}(\cos\vartheta)\sin\vartheta d\vartheta = \begin{cases} 0, & l' \neq l \\ \dfrac{2}{2l+1}, & l' = l \end{cases}$$
5. Find the vector potential of an infinite solenoid with n turns per unit length, radius R, and current I. (15%)
6. A coaxial cable consists of two very long cylindrical tubes, separated by linear insulating material of magnetic susceptibility χ_m. A current I flows down the inner conductor surface, Fig. 3. Find (a) the magnetic field in the region between the tubes, (b) the magnetization and (c) the bound currents. (15%)
7. Write down the differential form of Maxwell's equations in (a) free space with sources of free current and charge, and (b) good conductors. (c) Derive the wave equations of fields **E** and **B** in good conductor. (d) Find the plane wave solution **E** of part (c). Assuming the wave is linearly polarized and propagates in +z-direction. Express explicitly both the real and the imaginary part of the propagation vector. (e) What is the skin depth? (20%)

(背面仍有題目,請繼續作答)

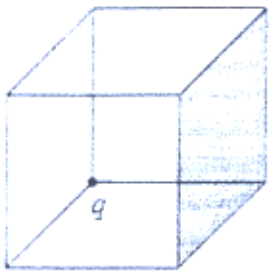

Fig. 1

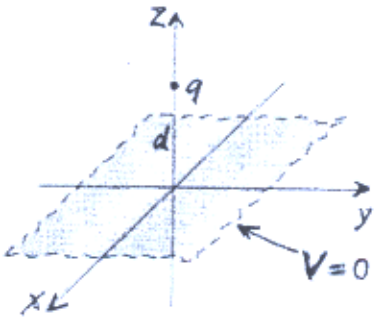

Fig. 2

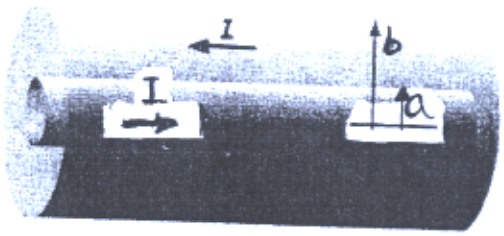

Fig. 3