1. (25pt.) Let a conducting but ungrounded sphere of radius R, be in the vicinity of a point charge q. If this sphere, in the charge-free space, has a total charge Q distributed uniformly over its surface.
   (a) Find the potential in the exterior region of the sphere. (13 pt.)
   (b) Find the force between the point charge q and the sphere. (12 pt.)

2. (25pt.) Suppose we have a uniform electric field over a region of space and we insert into this space a thin, but very large, conducting plate, as shown in Fig. 2.

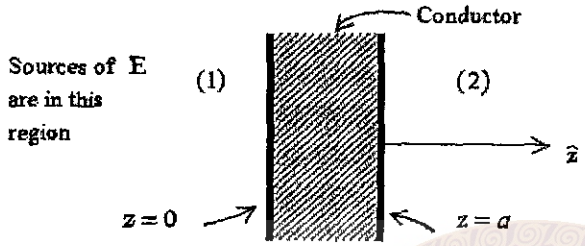

Fig. 2.

(a) Determine the potential in the region $z<0$ and $z>a$. (6pt.)
(b) Take the potential of the conductor to be zero (not ground), determine the charge densities at $z=0$ and $z=a$. (6 pt.) (c) Now the plate is grounded. Determine the charge densities at $z=0$ and $z=a$. Is there any shielding effect ? (6 pt.) (d) Determine the force per unit area on the plate before and after grounding. (7 pt.)

3. (25pt)

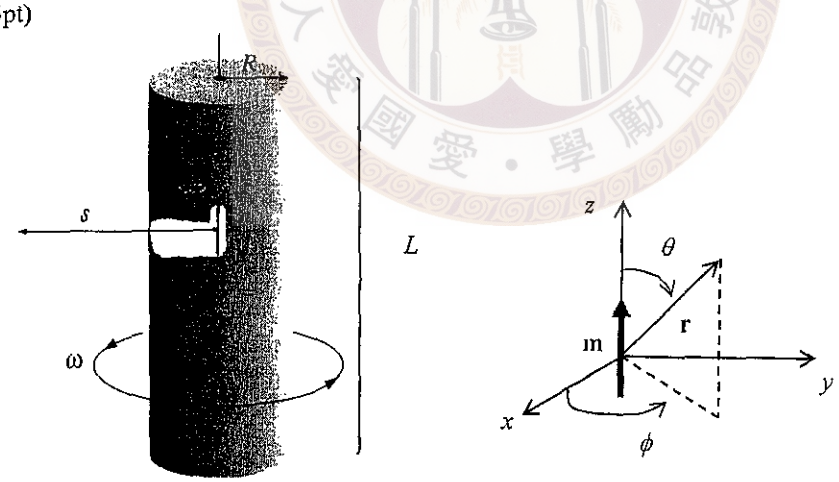

Fig. 3

A thin glass rod of radius R and length L carries a uniform surface charge σ. It is set spinning about its axis, at an angular velocity ω. Find the magnetic field at a distance $s >> R$ from the center of the rod (Fig. 3). [Hint: Treat it as a stack of magnetic dipole .]

4. (25pt.) (a) Write down and Maxwell's equations in matter together with the constitutive relations. (15pt.)
   (b). Derive the wave equations for the electromagnetic waves in vacuum. (10pt.)

試題隨卷繳回