1. (20%) A metal sphere with radius r and a total charge Q is placed a distance d above a grounded conducting plane. Find the potential in the region above the plane, and the charge density induced on the conducting plane.

2. (20%) A spherical conductor, of radius a, carries a charge Q. It is surrounded by linear dielectric material of susceptibility χ_e, from radius b out to c, as shown.

    Find the energy of this configuration, (1) a = b and (2) a = 0.5 b.
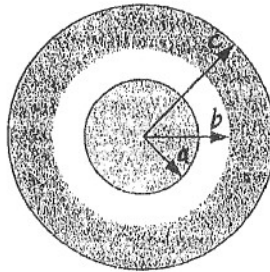
3. (15%) Discuss and comparison the role of **H** plays in magnetostatics and **D** plays in electrostatics.

4. (20%) Two long, straight copper pipes, each of radius a, are held a distance $2d$ apart, as shown. One is at potential V_0, the other at $-V_0$. The space surrounding the pipes is filled with weakly conducting material of conductivity σ. Find the current, per unit length, which flows from one pipe to the other.
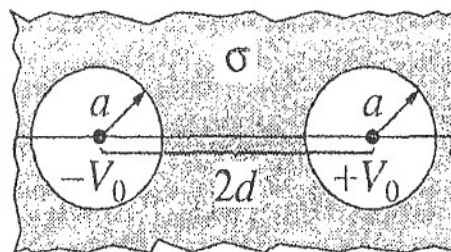
5. (15%) Show that the mode TE_{00} cannot occur in a rectangular wave guide.

6. (10%) Explain the hidden momentum of a magnetic dipole in an electric field.