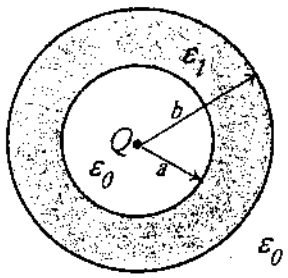
1. (*10 Points*)
   (a) Write down Maxwell's equations in integral form.
   (b) Write down the boundary conditions for electric flux density, electric field intensity, magnetic flux density and magnetic field intensity.

2. (*15 Points*)
   A charge Q is located at the center of a dielectric sphere as shown in the figure. Find and plot the electric flux density, electric field intensity, potential, polarization, and polarization charge density as functions of the distance r from the origin.



3. (*15 Points*)
   The electrostatic potential function between two parallel very large plates is given by $V(x) = Ax^{4/3} + Bx + C$ (A, B, C are constants), where x is the distance of a point between the plates from one of the plates. The permittivity of the dielectric between the plates is ε. Determine the electric field distribution and the volume charge density distribution, as functions of x.

4. (*15 Points*)
   Medium 1 ($z > 0$) has a dielectric constant of 2 and a conductivity of 4×10^{-5} mho/m. Medium 2 ($z < 0$) has a dielectric constant of 5 and a conductivity of 5×10^{-8} mho/m. If $\mathbf{J}_2$ has a magnitude of 2 A/m^2, and $\theta_2 = 60°$ with the normal to the interface, compute $\mathbf{J}_1$ and θ_1. What is the surface charge density at the interface ($z = 0$)?

5. (*15 Points*)
   (a) Find the magnetic field H at the center of a square loop carrying a current I. The side of the square loop is $a/4$ meters long. (b) A circular loop that has radius b and carries a current I produces the same magnetic field strength at the center. Find the ratio of b to a.

(背面仍有題目,請繼續作答)

6. (*15 Points*)

Two infinitely long transmission lines are connected together. One's characteristic impedance is 200 Ω and the other's is 50 Ω. If a wave at the 200 Ω line is propagating toward the junction, what are the reflection and the transmission coefficients? Design a transmission-line transformer to reduce the reflection to zero. What is the VSWR at this matching transmission line section?

7. (*15 Points*)

Given a characteristic impedance 50 Ω and a load impedance $Z_L = 100 - j\,50\ \Omega$, match the line to the given load using only transmission line sections. (Hint: you may use the Smith chart below, *temporarily*. But don't forget to write down important procedures and results on your answer sheet. Otherwise it will not be graded.)