بسم الله الرحمن الرحیم

Electrodynamics, 1st Homework assignment, Fall 1402, Due date: Aban 23

Questions 1 to 7 in this homework are about a conducting sphere having a concentric spherical hole inside. The inner and outer radii are a and b respectively. Note that the conditions in each question are independent of the others.

1. Find an appropriate Green's function for the hole regarding the Dirichlet boundary condition.
2. Consider the sphere at fixed potential V.
   (a) Find the potential everywhere ($0 \leq r < \infty$).
   (b) Find the surface charge density on both the inner and outer surfaces of the sphere.
3. Keep the sphere insulated with a net charge Q.
   (a) Find the potential everywhere ($0 \leq r < \infty$).
   (b) Find the surface charge density on both the inner and outer surfaces of the sphere.
   (c) Compare the results with those of question 2.
4. Take the sphere insulated but with a point charge q at a distance $R(< a)$ from the center inside the hole.
   (a) Find the potential everywhere ($0 \leq r < \infty$).
   (b) Find the surface charge density on both the inner and outer surfaces of the sphere.
5. Put the sphere at fixed potential V while having a point charge q at a distance $R(< a)$ from the center inside the hole.
   (a) Find the potential everywhere ($0 \leq r < \infty$).
   (b) Find the surface charge density on both the inner and outer surfaces of the sphere.
   (c) Compare the results with those of question 4.
6. Assume an insulated sphere with the net charge Q and a point charge q at a distance $R(< a)$ from the center inside the hole.
   (a) Find the potential everywhere ($0 \leq r < \infty$).
   (b) Find the surface charge density on both the inner and outer surfaces of the sphere.
   (c) Compare the results with those of questions 4 and 5.
7. Try to find an appropriate Green's function for the hole regarding the Neumann boundary condition.
8. Consider a thin conducting spherical shell of radius a concentric with another thin conducting spherical shell of radius $b(> a)$. The inner shell is grounded while the outer shell is insulated and has a net charge Q. Find the potential everywhere ($0 \leq r < \infty$).

Good Luck
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