FO-1 Statics
(Topics: electrostatics, magnetostatics, energy/force, boundary conditions, quasistatics)

Consider N separate equal-sized conducting spheres that are made of mercury. The radius of each sphere is a and all mercury spheres are maintained at the same potential V_0.

(A) (33 Points)

If all mercury spheres are now merged into one conducting sphere, find the potential of the resulting sphere. Mercury is incompressible (regular laboratory conditions) so the volume of the resulting sphere is the sum of the volumes of the individual spheres.

(B) (33 Points)

Find the electric field intensity at the surface of the resulting sphere. What is the ratio of the electric filed intensity on the resulting sphere to the field intensity on the initial sphere?

(C) (34 Points)

A small dielectric sphere of polarizability α and radius b is now placed at a great distance from the resulting conducting sphere.
Note that the polarizability of dielectric α in isotropic media is defined as the ratio of the induced dipole moment $\mathbf{p}$ *to the electric field* $\mathbf{E}$ *that produces this dipole moment such that:* $\mathbf{p} = \alpha\mathbf{E}$
Find the electric field at the location of the dipole and the energy of the induced dipole.

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