

4.50 If $\mathbf{E} = \hat{\mathbf{R}}300$ (V/m) at the surface of a 5-cm conducting sphere centered at the origin, what is the total charge Q on the sphere's surface?

Solution: From Table 4-3, $\hat{\mathbf{n}} \cdot (\mathbf{D}_1 - \mathbf{D}_2) = \rho_s$. \mathbf{E}_2 inside the sphere is zero, since we assume it is a perfect conductor. Hence, for a sphere with surface area $S = 4\pi a^2$,

$$D_{1R} = \rho_s, \quad E_{1R} = \frac{\rho_s}{\epsilon_0} = \frac{Q}{S\epsilon_0},$$
$$Q = E_R S \epsilon_0 = (300)4\pi(0.05)^2 \epsilon_0 = 3\pi \epsilon_0 \quad (\text{C}).$$
