

Introduction to Theoretical Physics

Problem set 3 until

Task 9-A

Consider two concentric metal spheres $i = 1, 2$ with the radii R_1 and $R_2 > R_1$. The inner sphere carries the charge $+Q$ while the outer sphere carries the opposite charge $-Q$. The charge is homogeneously distributed over the surfaces of the spheres.

- a) Calculate the electrostatic potential and the electric field \mathbf{E} for the entire space $0 \leq r < \infty$.

Hint: use the symmetries of the field (spherically symmetric) and Gauss's theorem.

- b) Calculate the capacity C of this system (spherical capacitor). The capacity is defined as $C = Q/(V_1 - V_2)$ whereas V_i is the potential on the sphere i .

Task 9-B

Calculate the magnetic field \mathbf{B} of two thin, parallel and infinitely long conductors of distance $2a$ with given currents I_1 and I_2 . Give this expression in Cartesian coordinates.

Furthermore calculate \mathbf{B} for $I_1 = -I_2$ under the assumption that the distance from the observer to the conductors is very large. How does \mathbf{B} scale at large distances?

(Hint: use the superposition principle!)