

UNIVERSITY OF LEIPZIG
INSTITUTE FOR THEORETICAL PHYSICS
Department: Theory of Elementary Particles

TP2 2017

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List of problems 4

9. A sphere of radius R_1 has charge density ρ uniform within its volume, except for a small spherical hollow region of radius R_2 located at a distance a from the center ($R_2 + a < R_1$).
Find the electric field vector \mathbf{E} and the electrostatic potential Φ inside the hollow sphere.
What is the potential at the center of the hollow sphere?
Hint: Use the superposition of two uniformly and oppositely charged spheres.
10. An amount of charge q is uniformly spread out in a layer on the surface of a disc of radius a .
Find the electrostatic potential $\Phi(z)$ at any point on the axis of symmetry ($z > 0$ and $z < 0$).
Calculate the vector of the electric field $\mathbf{E}(z)$ on that axis.
11. A very long hollow metallic cylinder of inner radius r_0 and outer radius $r_0 + \Delta r$ ($\Delta r \ll r_0$) is uniformly filled with space charge per unit cylinder length of density ρ_0 (inside r_0).
What are the electric field vectors for $r < r_0$, $r > r_0 + \Delta r$, and $r_0 < r < r_0 + \Delta r$?
What are the surface charge densities on the inner and outer surfaces of the cylinder? The net charge on the cylinder is assumed to be zero.
What are the fields and surface charges if the cylinder is grounded?
Hint: A grounded object in electrostatics is held at a fixed potential.