

# 7th Exercise Sheet: Electrodynamics, Summer Term '06

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7. 1. (**Präsenzübung: dielectric ball in an electric field, 1+1 marks**) Consider a dielectric ball with dielectric constant  $\epsilon_i$  in a static electric field. Outside of the ball, there is vacuum ( $\epsilon_a = 1$ ). The electric field outside of the ball is homogeneous for large distances from the ball. Calculate the potential and the electric field inside and outside of the ball. **Auxiliary questions** (Questions which might help you to prepare yourself for the test):
- (a) Which symmetries do this test arrangement have? Which 'ansatz' for the potential is therefore promising? Write the full potential as a sum of the potential inside and outside of the ball! Which coordinates are appropriate for the calculation?
  - (b) Formulate the boundary conditions for the potential for  $r \rightarrow \infty$  mathematically!
  - (c) What are the conditions for the potential on the surface of the ball? Why?
  - (d) What are the conditions for the normal component of  $\vec{D}$ ? Why?
  - (e) Give the properties of Legendre-polynomials!
  - (f) Use the boundary conditions found in (b), (c) und (d) and your ansatz found in (a) in order to calculate the potential! Use the properties of the Legendre-polynomials!
  - (g) Calculate the electric field inside and outside of the ball!
  - (h) How is the electric field inside and outside of the ball called? Sketch the electric fields!