Theoretische Physik 2 (Elektrodynamik) WS 2018/2019
Technische Universität München
November 23, 2018

Exercise Sheet 6*

Deadline: Sheet to be turned in by Friday 30th of November 2018 by 12 pm in the mailbox next to PH3218.

Exercise 1:
Electric potential outside a sphere with boundary conditions **3 Points**

Calculate the potential outside of a sphere of radius R that is cut into two halves that are maintained at opposite potential $\pm V$.

Hint: The inside potential has been calculated in the lecture.

Exercise 2:
A conducting spherical shell in a uniform field **4 Points**

An insulated, spherical, conducting shell of radius a is in a uniform electric field E_0 (pointing along the z axis). When the sphere is cut into two hemispheres by a plane perpendicular to the field (such that the contact between the hemispheres remains conducting), find the force required to prevent the hemispheres from separating

(a) if the shell is uncharged;

(b) if the total charge on the shell is Q.

Hint: You can obtain the homogeneous electric field by placing point charges $\pm Q$ at $z = \mp R$ and take the limit $R \to \infty$ while keeping Q/R^2 fixed. The response of the sphere on the electric field can then be represented by image charges as it has been discussed in the lectures. After placing the image charges, we can calculate the potential and induced charge density of the hemispheres and therefore the force upon them coming from the (modified) electric field.

Exercise 3:
Dot product in terms of spherical functions **3 Points**

(a) Write down the Cartesian components of the two position vectors $\vec{r}$ and $\vec{r}'$ in terms of spherical functions.

(b) Calculate the scalar product $\vec{r} \cdot \vec{r}'$.

(c) Check the result with the help of the addition theorem for spherical functions.

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