Theoretische Physik 2 (Elektrodynamik) WS 2018/2019
Technische Universität München
November 7, 2018

Exercise Sheet 4*

Deadline: Sheet to be turned in by Friday 16th of November 2018 by 12 pm in the mailbox next to PH3218.

Exercise 1:
Method of images I **4 Points**

Using the method of images, discuss the problem of a point charge q inside a hollow, grounded, conducting sphere of inner radius a. Find

(a) the potential inside the sphere,

(b) the induced surface-charged density on the inner surface,

(c) the magnitude and direction of the force acting on q.

(d) Is there any change in the solution if the sphere is kept at a fixed potential V? If the sphere has a total charge Q on its inner and outer surfaces?

Exercise 2:
Computation of electric potential in 2 dimensions **3 Points**

(a) Compute the Green's function for a two-dimensional potential problem with homogeneous boundary conditions.

Hint: Use polar coordinates.

(b) Compute the potential associated to a point charge q located at $\vec{r}_0 = (x_0, y_0)$, with $x_0, y_0 > 0$ where the axis ($x = 0$ and $y = 0$) are fixed at zero potential.

Hint: Use the method of images.

Exercise 3:
Variational principle for the field energy **3 Points**

Let the electric potential $\Phi(\vec{r})$ be given at the boundary R of a region of space V where the potential is such that it corresponds to the minimization of the following functional

$$W[\Phi] = \frac{1}{8\pi} \int_V \mathrm{d}^3\vec{r} (\nabla\Phi(\vec{r}))^2. \tag{1}$$

Derive a differential equation for $\Phi(\vec{r})$ by using variational methods ($\delta W = 0$).

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