TFY4240

Problem set 4 Autumn 2015

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Problem 1.
Let an infinitesimal electric dipole of constant dipole moment $\boldsymbol{p}$ be located at position $\boldsymbol{r}'$ relative a given coordinate system.

a) Argue why the scalar potential at position $\boldsymbol{r}$ has the form

$$V(\boldsymbol{r}) = \frac{1}{4\pi\varepsilon_0}\frac{\boldsymbol{p}\cdot\hat{\boldsymbol{R}}}{R^2}, \qquad \boldsymbol{R} = \boldsymbol{r} - \boldsymbol{r}'. \tag{1}$$

Notice that the difference between this expression and what was done in the lectures (or in the book) is that the dipole is now not necessarily located at the origin of the coordinate system.

b) Use Eq. (1) to obtain the corresponding electric field, $\boldsymbol{E}(\boldsymbol{r})$. Express our answer in terms of, for instance, $\boldsymbol{p}\cdot\hat{\boldsymbol{R}}$, $\boldsymbol{R}$ and $\boldsymbol{p}$ so that it is in *coordinate free form*. The answer that you should obtain resembles Eq. (3.104) from the textbook.

Problem 2.
Go through examples 4.5, 4.7 and 4.8 from Griffiths.

Problem 3.
Go through examples 5.5, 5.6, and 5.9 from Griffiths.