6. Tutorium - Resultate **06.05.2016**

6.1 Elektrische Feldenergie

a) $\rho(\vec{r}) = \sigma_0 \delta(r - R)$, mit $\sigma_0 = \frac{Q}{4\pi R^2}$.
$V(\vec{r}) = \frac{Q}{4\pi\epsilon_0} \begin{cases} \frac{1}{r} & r > R \\ \frac{1}{R} & r < R \end{cases}$
$\vec{E}(\vec{r}) = \vec{e}_r \frac{Q}{4\pi\epsilon_0} \begin{cases} \frac{1}{r^2} & r > R \\ 0 & r < R \end{cases}$
b) $\vec{E}_r(r \to R^+) - \vec{E}_r(r \to R^-) = \frac{Q}{4\pi\epsilon_0 R^2} = \frac{\sigma_0}{\epsilon_0}$
c) $U = \frac{1}{2} \frac{Q^2}{4\pi\epsilon_0} \frac{1}{R}$

6.2 Multipolmomente eines Kreuzes

a) $\rho(\vec{x}) = \lambda \left[\theta(a + x)\theta(a - x)\delta(y)\delta(z) + \theta(b + y)\theta(b - y)\delta(x)\delta(z)\right]$
$Q = 2\lambda(a + b)$
b) $p_i = 0$
$Q_{xx} = \frac{2\lambda}{9}(2a^3 - b^3)$
$Q_{yy} = \frac{2\lambda}{9}(-a^3 + 2b^3)$
$Q_{zz} = \frac{2\lambda}{9}(-a^3 - b^3)$
$Q_{xy} = Q_{yx} = \ldots = 0$
c) $\phi(0, 0, z) = \frac{2\lambda(a+b)}{z} + \frac{\lambda(-a^3-b^3)}{3z^3}$
d) $\vec{E}(0, 0, z) = \left[\frac{2\lambda(a+b)}{z^2} + \frac{\lambda(-a^3-b^3)}{z^4}\right] \vec{e}_z$

6.3 Punktdipol und Punktladung

a) $\vec{F}_q = -\frac{1}{4\pi\epsilon_0} \frac{qp}{x_1^3} \vec{e}_z$
$\vec{F}_d = \frac{1}{4\pi\epsilon_0} \frac{qp}{x_1^3} \vec{e}_z = -\vec{F}_q$
b) 0.
c) $W = \frac{1}{4\pi\epsilon_0} \frac{qpz_2}{(x_2^2+y_2^2+z_2^2)^{3/2}}$
$\vec{F} = \frac{qp}{4\pi\epsilon_0} \left(\frac{3z_2\vec{x}_2}{r_2^5} - \frac{\vec{e}_z}{r_2^3}\right)$