HGÜ 4   A6   (1)   16.11.09

Gauß: $\iint \vec{E}\,\varepsilon\, d\vec{A} = Q$

$$U_{12} = \int_{\rho_1}^{\rho_2} \vec{E}\, d\vec{s} \qquad C = \frac{Q}{U}$$

a) $Q = q_L \cdot d$ $\qquad \oiint \vec{E}\, d\vec{A} = \frac{Q}{\varepsilon}$ $\qquad \left(q_L = \sigma_e\, 2\pi \rho_1\right)$

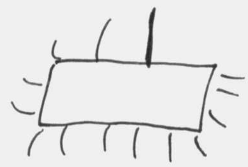
(Herleitung Spannung 2-44)

$$\Leftrightarrow 2\pi \rho\, d\, E_\rho(\rho) = \frac{Q}{\varepsilon} \Rightarrow \vec{E} = \frac{q_L}{2\pi\rho\varepsilon}\vec{e}_\rho \quad (I)$$

$$U = \int_{\rho_1}^{\rho_2} \vec{E}\, d\vec{s} = \frac{q_L}{2\pi\varepsilon} \ln\left(\frac{\rho_2}{\rho_1}\right) \qquad \left(d\vec{s} = d\rho\, \vec{e}_\rho\right) \quad (II)$$

b) I und II ergeben: $\vec{E} = \frac{U}{\rho \ln\left(\frac{\rho_2}{\rho_1}\right)} \cdot \vec{e}_\rho$

c) $E_{max} = \left|\vec{E}(\rho_1)\right| = \frac{U}{\rho_1 \ln\left(\frac{\rho_2}{\rho_1}\right)}$



d) $C_1 = \frac{Q}{U} = \frac{q_L \cdot d}{q_L \ln\left(\frac{\rho_2}{\rho_1}\right)} \cdot 2\pi\varepsilon = \frac{2\pi\varepsilon d}{\ln\left(\frac{\rho_2}{\rho_1}\right)}$ ohne Streufeld!!

e) siehe S. 52 Differenzpotentiale ...

$\Rightarrow$ für 4 Gitterpunkte muss das Potential berechnet werden

$$\phi_{a1} = \phi_{e1} = \phi_{a5} = \phi_{e5}$$

$$\phi_{b1} = \phi_{a2} = \phi_{d1} = \phi_{e2} = \phi_{a4} = \phi_{b5} = \phi_{d5} = \phi_{e4}$$

$$\phi_{c1} = \phi_{e3} = \phi_{c5} = \phi_{a3}$$

$$\phi_{b2} = \phi_{d2} = \phi_{d4} = \phi_{b4}$$

f) $\phi_{a1} = 1/4\,(0 + 0 + \phi_{b1} + \phi_{a2}) = 1/4 \cdot 2\,\phi_{b1}$

$$\phi_{b1} = 1/4\,(0 + \phi_{a1} + \phi_{c1} + \phi_{d2})$$

$$\phi_{c1} = 1/4\,(U + 2\,\phi_{b1})$$

$$\phi_{d2} = 1/4\,(2U + 2\,\phi_{b1})$$

$$\begin{bmatrix} \phi_{a1} \\ \phi_{b2} \\ \phi_{c1} \\ \phi_{d1} \end{bmatrix} = \frac{U}{20} \begin{bmatrix} 3 \\ 6 \\ 8 \\ 13 \end{bmatrix}$$