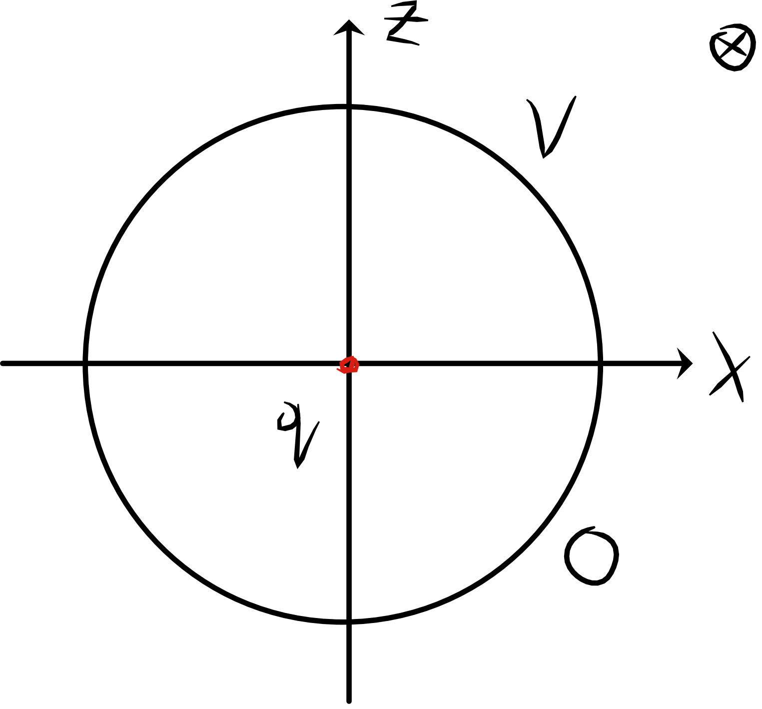

$$\Phi(R,\theta) = \begin{cases} V & \text{dla } \theta \in [0; \frac{\pi}{2}[\\ 0 & \text{dla } \theta \in]\frac{\pi}{2}; \pi] \end{cases}$$

$$\Phi(r<R,\theta) = \frac{q}{4\pi\varepsilon_0 r} + \sum_{l=0}^{\infty} A_l r^l P_l(\cos\theta)$$

$$\frac{q}{4\pi\varepsilon_0 R} P_0(\cos\theta) + \sum_{l=0}^{\infty} A_l R^l P_l(\cos\theta) = \Phi(R,\theta) \quad \Big/ \int_0^{\pi} P_{l'}(\cos\theta)\sin\theta\, d\theta$$

$$\frac{q}{4\pi\varepsilon_0 R} \left.\frac{2}{2l+1}\right|_{l=0} + A_l R^l \frac{2}{2l+1} = V \underbrace{\int_0^{\frac{\pi}{2}} P_l(\cos\theta)\sin\theta\, d\theta}_{W_l}$$

$$W_0 = 1 \qquad W_1 = \frac{1}{2}$$

$$A_1 = \frac{3}{R}\left(\frac{V}{4} - \frac{q}{4\pi\varepsilon_0 R}\right)$$

$$A_l = \frac{2l+1}{R^l}\left(\frac{-q}{4\pi\varepsilon_0 R} + \frac{V}{2} W_l\right)$$

bez pierwszego wyrazu, bo q samo na siebie nie działa

$$E = -\nabla\Phi = -\frac{\partial\Phi}{\partial r}\bar{e}_r - \frac{1}{r}\frac{\partial\Phi}{\partial\theta}\bar{e}_\theta = \bar{e}_r\left(-\sum_{l=1}^{\infty} A_l l r^{l-1} P_l(\cos\theta)\right) + \bar{e}_\theta\left(-\sum_{l=1}^{\infty} A_l r^{l-1} P_l'(\cos\theta)\right) =$$

zaczynam od $l=1$, bo dla $l=0$ jest pochodna stałej

E liczę w $r=0$, więc przeżywa tylko $l=1$

$$= -A_1(\cos\theta\,\bar{e}_r - \sin\theta\,\bar{e}_\theta) = -A_1\bar{e}_z = \left(\frac{3q}{4\pi\varepsilon_0 R^2} - \frac{3V}{4R}\right)\bar{e}_z$$

$$\bar{F} = q\left(\frac{3q}{4\pi\varepsilon_0 R^2} - \frac{3V}{4R}\right)\bar{e}_z$$