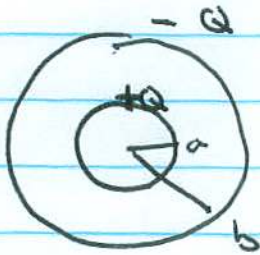


4-14



$$\text{for } a \leq r \leq b$$

$$\vec{E} = \frac{Q}{4\pi\epsilon_0 r^2} \hat{r}, \text{ else } \vec{E} = 0$$

$$u_E = \frac{1}{2} \epsilon_0 E^2 = \frac{Q^2}{32\pi^2 \epsilon_0 r^4}$$

$$U = \int_a^b u_E d^3x = 4\pi \int_a^b u_E r^2 dr = \frac{Q^2}{8\pi\epsilon_0} \int_a^b \frac{dr}{r^2}$$

$$= \frac{Q^2}{8\pi\epsilon_0} \left(-\frac{1}{b} + \frac{1}{a} \right) = \frac{Q^2}{8\pi\epsilon_0} \left(\frac{1}{a} - \frac{1}{b} \right)$$

$$U = \frac{Q^2}{2C} \rightarrow C = \left[\frac{1}{4\pi\epsilon_0} \left(\frac{1}{a} - \frac{1}{b} \right) \right]^{-1}$$

$$= \frac{4\pi\epsilon_0 ab}{b-a}$$