set 8

sphere uniform, radially outward

$$E = \iint_S \frac{\rho_s \, dS}{4\pi\varepsilon_0 R^2} \underset{\sim}{a_r}$$

$$= \frac{\rho_s}{4\pi\varepsilon_0 r^2} \int_0^{2\pi}\int_0^{\pi} r^2 \sin\theta \, d\theta \, d\phi \, \underset{\sim}{a_r}$$

↳ $r=1$

$$= \frac{\rho_s}{4\pi\varepsilon_0 r^2} \cdot 2\pi \cdot \cos\theta \Big|_0^{\pi}$$

$$= \frac{\rho_s}{\varepsilon_0 r^2}$$

$$W = \frac{1}{2}\iiint_V \varepsilon_0 E^2 \, dV$$

$$= \frac{1}{2}\int_0^{2\pi}\int_0^{\pi}\int_2^3 \varepsilon_0 \left(\frac{\rho_s}{r^2\varepsilon_0}\right)^2 r^2 \sin\theta \, dr\, d\theta\, d\phi$$

$$= \frac{\rho_s^2}{2\varepsilon_0}\int_0^{2\pi}\int_0^{\pi}\int_2^3 \frac{1}{r^2}\sin\theta \, dr\, d\theta\, d\phi$$

$$= \frac{(2\times 10^{-6})^2}{2 \cdot \frac{10^{-9}}{36\pi}} \cdot 2 \cdot 2\pi \cdot \left(\frac{1}{2} - \frac{1}{3}\right)$$

$$= 0.4737$$