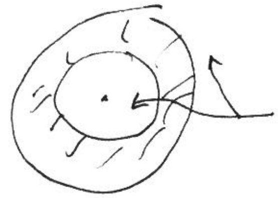
341 – ch6 – Class 17 – 2, 4

2) separate:

$E = \frac{q}{4\pi\varepsilon_0 r^2}$

within



$E = \frac{q}{4\pi\varepsilon_0 r^2}$

the difference is zero except within the dielectric

separate: $\frac{1}{2} \frac{q^2}{(4\pi r^2)^2 \varepsilon_0}$ $E \cdot D$

inside dielectric: $E \to E/K$, D unchanged

$\frac{1}{K} \times \frac{1}{2} \frac{q^2}{(4\pi r^2)^2 \varepsilon_0}$

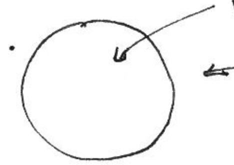
$$\Delta u = \int_a^b \frac{1}{2} \frac{q^2}{(4\pi r^2)^2 \varepsilon_0} \left(\frac{1}{K} - 1\right) 4\pi r^2 dr$$

$$= \frac{q^2}{4\pi\varepsilon_0}\left(\frac{1}{K} - 1\right) \int_a^b \frac{1}{r^2} dr = \frac{q^2}{4\pi\varepsilon_0}\left(\frac{1}{K} - 1\right)\left[-\frac{1}{r}\right]_a^b$$

$$= \frac{q^2}{4\pi\varepsilon_0}\left(\frac{1}{K} - 1\right)\left(\frac{1}{a} - \frac{1}{b}\right)$$

[negative ... lower energy when inside]

4)



$E = 0$

$E = \frac{q}{4\pi\varepsilon_0 r^2}$

$\phi = \frac{q}{4\pi\varepsilon_0 r}$

(a) $\frac{1}{2} q \phi = \frac{1}{2} \frac{q^2}{4\pi\varepsilon_0 R}$

(b) $$u = \frac{1}{2} \int_R^\infty \frac{q^2}{(4\pi r^2)^2 \varepsilon_0} 4\pi r^2 dr = \frac{1}{2} \frac{q^2}{4\pi\varepsilon_0} \int_R^\infty r^{-2} dr$$

$$= \frac{1}{2} \frac{q^2}{4\pi\varepsilon_0} \frac{1}{R}$$