(a) What is change per unit area? (on conducting plates)


\[ E = \frac{E_0}{K} \Rightarrow \sigma = KE \]  

Combine these relations we get

\[ \sigma = \varepsilon_0 E_0 = \varepsilon_0 KE \]

\[ \varepsilon_0 = 8.85 \times 10^{-12} \text{F/m} \]

\[ K = 3.82 \times 10^{-11} \text{F/m} \]

\[ \sigma = 3.82 \times 10^{-11} \text{C/m}^2 \text{ surface charge density} \]

(b) What is change per unit area (on dielectric surface)?

Eq. 2.4-16, p. 9611 (induced surface charge density)

\[ \sigma_{\text{induced}} = \sigma_c = \sigma \left(1 - \frac{1}{K}\right) = 3.82 \times 10^{-11} \left(1 - \frac{1}{3.82}\right) \]

\[ \sigma_c = 2.72 \times 10^{-11} \text{C/m}^2 \]

(c) Total energy stored in capacitor?

\[ U = \frac{1}{2} CV^2 \text{ but we don't have C or V} \? \]

But from eq. 2.4-10, p. 9611

\[ \text{energy density} = \frac{1}{2} CV^2 = U \]

\[ A \text{ area of dielectric slab} \]

\[ V = A \times d \text{ } \]

\[ U = \frac{1}{2} KE_0 E^2 = \frac{1}{2} KE^2 \]
Therefore,

\[ U = u Ad = \left( \frac{1}{2} Ke E^2 \right) Ad \]

we have all three quantities.

\[ U = \frac{1}{2} (3.60) (8.85 \times 10^{-12}) \left( \frac{1.20 \times 10^6 \text{ V}}{2.50 \times 10^{-4} \text{ m}} \right)^2 (1.80 \times 10^{-3} \text{ m}) \]

\[ U = 1.03 \times 10^{-5} \text{ J} \]