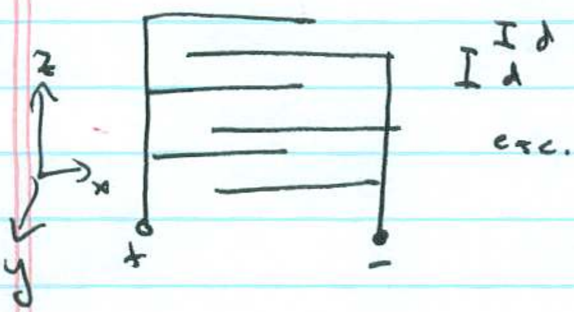
6-13



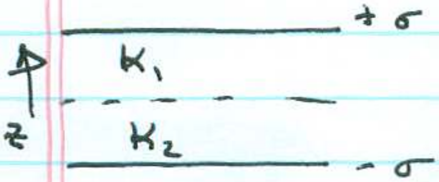
Total volume = $5Ad$

Between 2 plates, $\bar{E} = \pm \frac{V}{d} \hat{k}$

$$U = \int \frac{1}{2} \bar{D} \cdot \bar{E} \, d^3x = \frac{\varepsilon}{2} \left(\frac{V}{d}\right)^2 (5Ad)$$
$$= \frac{1}{2} \frac{5 \varepsilon A}{d} V^2$$

but $U = \frac{1}{2} C V^2$
$$\longrightarrow C = 5 \varepsilon A / d$$

6-14



a) $\bar{D} = ?$ $\oint \bar{D} \cdot d\bar{A} = -D_z A = \sigma A$ on top

or $= D_z A = (-\sigma) A$ on bottom

$\bar{D} = \sigma \hat{k}$ (no free charge at interface, $\bar{D}$ is continuous)

b) $\bar{E} = \bar{D}/\varepsilon$; $\bar{E} = \bar{D}/\varepsilon_1 = \frac{\sigma}{K_1 \varepsilon_0} \hat{k}$ in top

$= \bar{D}/\varepsilon_0 = \frac{\sigma}{K_2 \varepsilon_0} \hat{k}$ in bottom

c) $\sigma_b = ?$ $\sigma_b = \bar{P} \cdot \hat{n}$

at top $\sigma_b^{top} = \hat{k} \cdot \bar{P}_1 = -\left(1 - \frac{1}{K_1}\right) \sigma$

at bottom, $\hat{n} = -\hat{k}$, $\sigma_b^{bottom} = -\hat{k} \cdot \bar{P}_2 = +\left(1 - \frac{1}{K_2}\right) \sigma$

at middle $\sigma_b^{middle} = -\hat{k} \cdot \bar{P}_1 + \hat{k} \cdot \bar{P}_2 = \left(\frac{1}{K_2} - \frac{1}{K_1}\right) \sigma$

d) $C = Q/V$
$$= \frac{\sigma L^2}{E_1 d/2 + E_2 d/2} = \frac{2L^2}{(1/K_1 + 1/K_2) d/\varepsilon_0} = \frac{2 K_1 K_2}{K_1 + K_2} \frac{\varepsilon_0 L^2}{d}$$