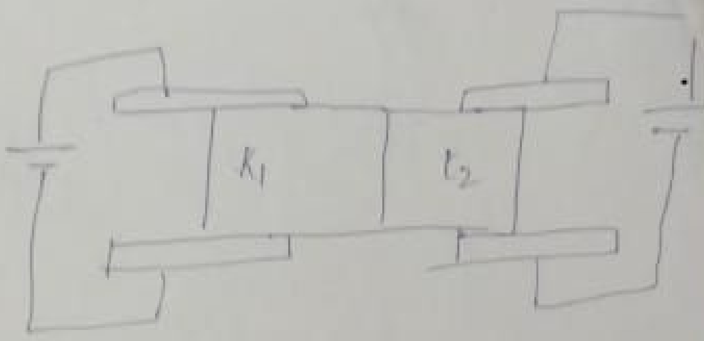
67 / HCV C_1



Suppose x is the distance to which dielectric is inserted

$C_1 = \frac{K_1 \epsilon_0 b . x}{d}$ w/o dielectric $C_2 = \frac{\epsilon_0 b (l_1 - x)}{d}$.

they are in parallel

$$C = C_1 + C_2 = \frac{\epsilon_0 b}{d}\left[l_1 + x(K_1 - 1)\right]$$

Let the potential is V_1

so $$U = \frac{1}{2} C V_1^2 = \frac{\epsilon_0 b . V_1^2}{2d}\left[l_1 + x(K_1 - 1)\right]$$

total work done on capacitor = work done by battery + work done external

$$= (dC) V^2 - \int f . dx$$

let f is the external force.

this workdone should be equal to increase in energy

so $(dC)V^2 - f \cdot dx = \frac{1}{2} \cdot (dK) V^2$

$$f = \frac{1}{2} V^2 \cdot \frac{dC}{dx}$$

$$\frac{dC}{dx} = \frac{d}{dx}\left(\frac{\epsilon_0 b}{d}\right)\left[l_1 + x(K_1 - 1)\right] = \frac{\epsilon_0 b}{d}(K_1 - 1).$$

so $f = \frac{1}{2} V_1^2 \frac{\epsilon_0 b}{d}(K_1 - 1).$

$$V_1 = \sqrt{\frac{f \times 2d}{\epsilon_0 b (K_1 - 1)}}.$$

Similarly for another cap. $V_2 = \sqrt{\frac{f \times 2d}{\epsilon_0 b (K_2 - 1)}}$

$$\boxed{\frac{V_1}{V_2} = \sqrt{\frac{K_2 - 1}{K_1 - 1}}}$$