

Problema ② del documento: (Clase 5 (4 Nov. 2025))
 (página web del curso) ①

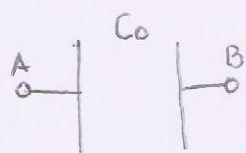
$$A = 0.20 \text{ m}^2$$

$$d = 1 \times 10^{-2} \text{ m}$$

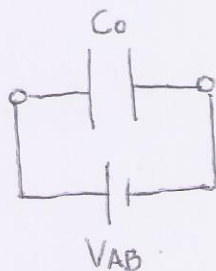
$$V_{AB} = 3000 \text{ V}$$

$$V_{AB}' = 1000 \text{ V}$$

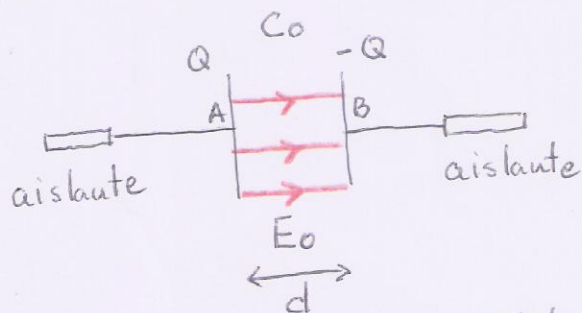
a) $K = ?$



(Sin dieléctrico)

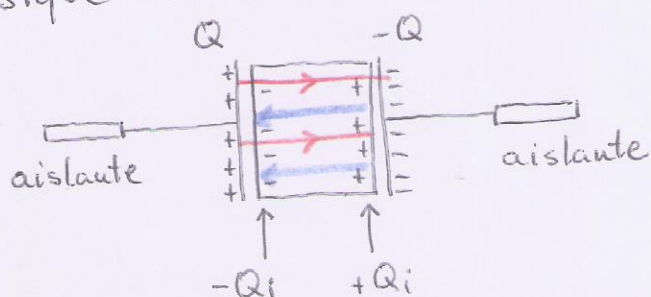


Se aísla el condensador (se desconecta primero de la batería)



$$V_{AB} = E_0 d \quad (1)$$

Se introduce el dieléctrico entre sus placas (condensador sigue aislado)



$$E_0 = \frac{\sigma}{\epsilon_0} \quad (2) \quad E_i = \frac{\sigma_i}{\epsilon_0} \quad (3) \quad Q = \text{carga libre}$$

$$Q_i = \text{carga ligada}$$

$$\sigma = \frac{Q}{A} \quad (4) \quad \sigma_i = \frac{Q_i}{A} \quad (5)$$

$$E = E_0 - E_i = \frac{\sigma}{\epsilon_0} - \frac{\sigma_i}{\epsilon_0} \quad (6)$$

$$E = \frac{E_0}{K} \quad (7)$$

La nueva d.d.p.e (voltaje) entre las placas del condensador con dieléctrico es

$$V_{AB}' = E d = \frac{E_0 d}{K} = \frac{V_{AB}}{K} \quad (8)$$

$$K = \frac{V_{AB}}{V_{AB}'} = \frac{3000 \text{ V}}{1000 \text{ V}} \Rightarrow K = 3 \quad (9)$$

(2)

$$b) (7) \Rightarrow E = \frac{E_0}{K} \quad (10)$$

$$(2) \Rightarrow E_0 = \frac{\sigma}{\epsilon_0} \quad (11)$$

$$(4) \Rightarrow \sigma = \frac{Q}{A} \quad (12)$$

c) Q ? Q = carga en la placa + del condensador sin dieléctrico

$$C_0 = \frac{Q}{V_{AB}} \Rightarrow Q = C_0 V_{AB} \quad (13)$$

d) C_0 ? Condensador de placas paralelas sin dieléctrico

$$\Rightarrow C_0 = \epsilon_0 \frac{A}{d} \quad (14)$$

$$\text{con } \epsilon_0 = 8.85 \times 10^{-12} \frac{\text{F}}{\text{m}}, \quad A = 0.20 \text{ m}^2 \text{ y } d = 1 \times 10^{-2} \text{ m} \quad (15)$$

$$\Rightarrow C_0 = \left(8.85 \times 10^{-12} \frac{\text{F}}{\text{m}} \right) \frac{0.20 \text{ m}^2}{1 \times 10^{-2} \text{ m}} = 8.85 \times 2 \times 10^{-11} \text{ F}$$

$$C_0 = 1.77 \times 10^{-10} \text{ F} = 177 \times 10^{-12} \text{ F} = 177 \text{ pF} \quad 1 \text{ pF} = 1 \text{ picrofaradio}$$

$$(13) \Rightarrow Q = C_0 V_{AB} = (177 \times 10^{-12} \text{ F})(3000 \text{ V}) = 5.31 \times 10^{-7} \text{ C} \\ = 0.531 \times 10^{-6} \text{ C} \\ = 0.531 \mu\text{C}$$

(3)

$$(10), (11) \text{ y } (12) \Rightarrow E = \frac{E_0}{K} = \frac{(\sigma/\epsilon_0)}{K} = \frac{Q/A\epsilon_0}{K} = \frac{Q}{A\epsilon_0 K}$$

$$\Rightarrow E = \frac{5.31 \times 10^{-7} \text{ C}}{(2 \times 10^{-1} \text{ m}^2)(8.85 \times 10^{-12} \frac{\text{F}}{\text{m}}) 3} = \frac{5.31}{2 \times 8.85 \times 3} \frac{10^{-7} \text{ C}}{10^{-13} \text{ F} \cdot \text{m}}$$

$$E = 0.1 \times 10^6 \frac{\text{V}}{\text{m}} = 1 \times 10^5 \frac{\text{V}}{\text{m}} = 100.000 \frac{\text{V}}{\text{m}}$$

$$c) \sigma_i = \sigma \left(1 - \frac{1}{K}\right)$$

$$\frac{\sigma_i}{\sigma} = 1 - \frac{1}{K} = 1 - \frac{1}{3} \Rightarrow \frac{\sigma_i}{\sigma} = \frac{2}{3}$$