Fisica II: Capacitores

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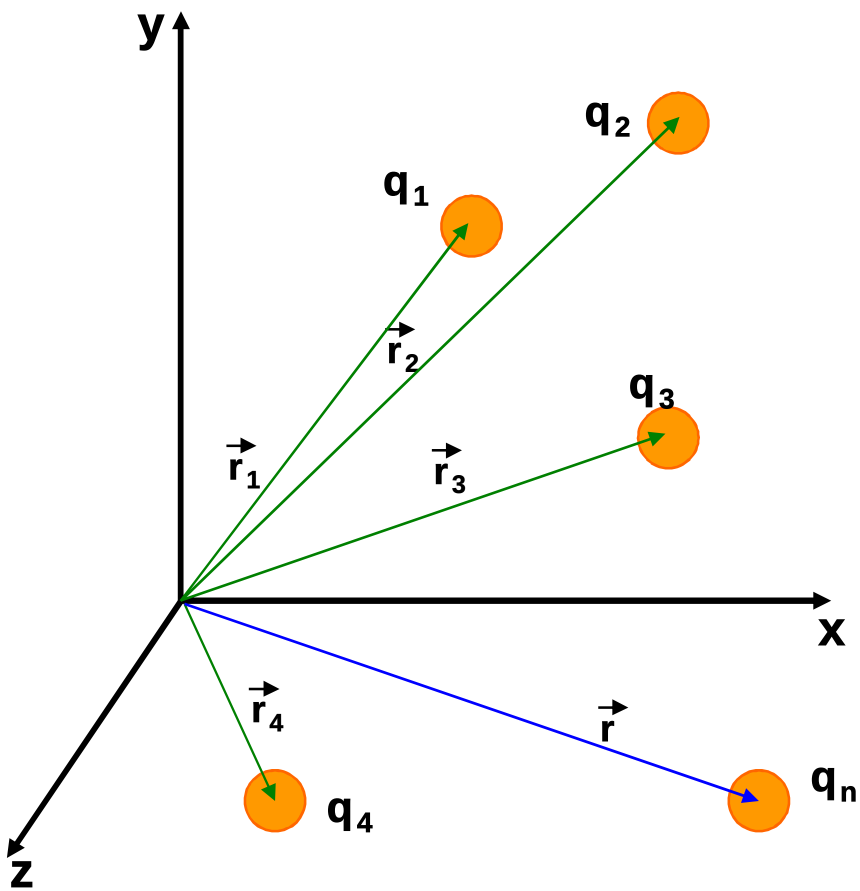
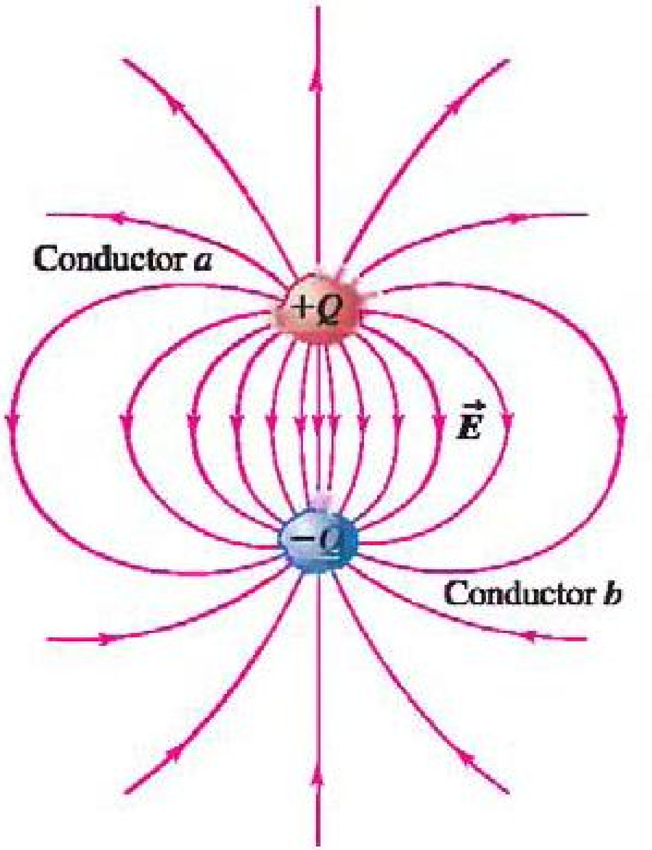
- **Bibliografía consultada: Sears- Zemasnky -Tomo II**
  Serway- Jewett – Tomo II

CAPACITORES

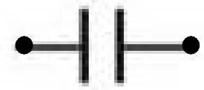


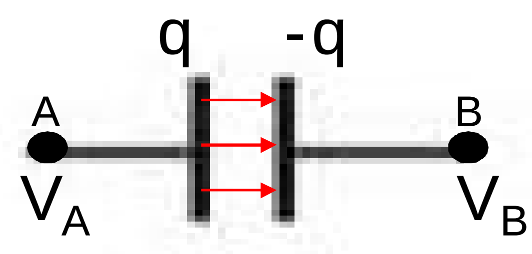
$$U = \sum_{\substack{i<j \\ i\neq j}} \frac{q_i q_j}{4\pi\varepsilon_0 r_{ij}}$$


.68 MFD
200 VDC
MAX SURGE 250VDC



$$Q_T = q_1 + q_2 = 0$$





$$V_A > V_B$$

$$\frac{q}{\Delta V} = cte$$

$$\mathbf{capacidad = C}$$

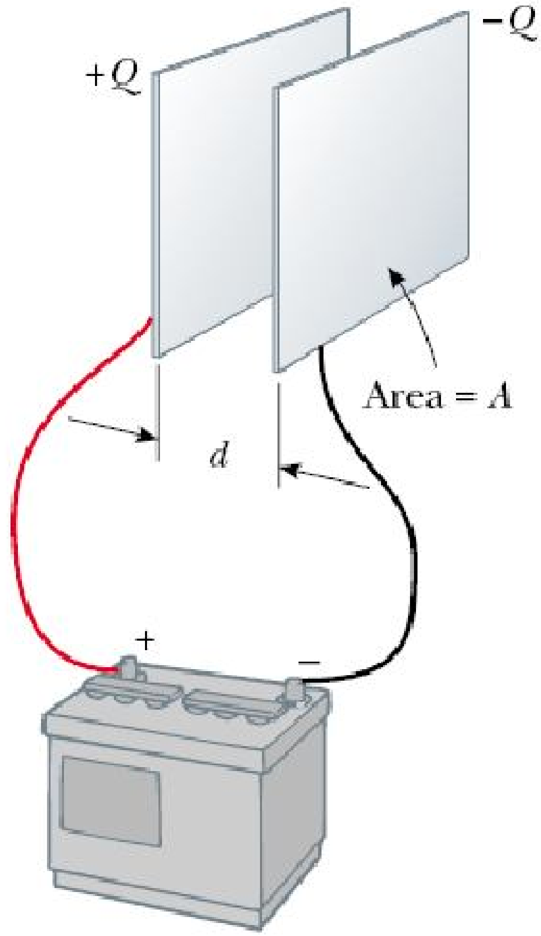
Medida de la habilidad de un capacitor para almacenar energía.
Depende de la geometría del sistema

$$C = \frac{q}{\Delta V} = \frac{q}{V_A - V_B} \geq 0$$

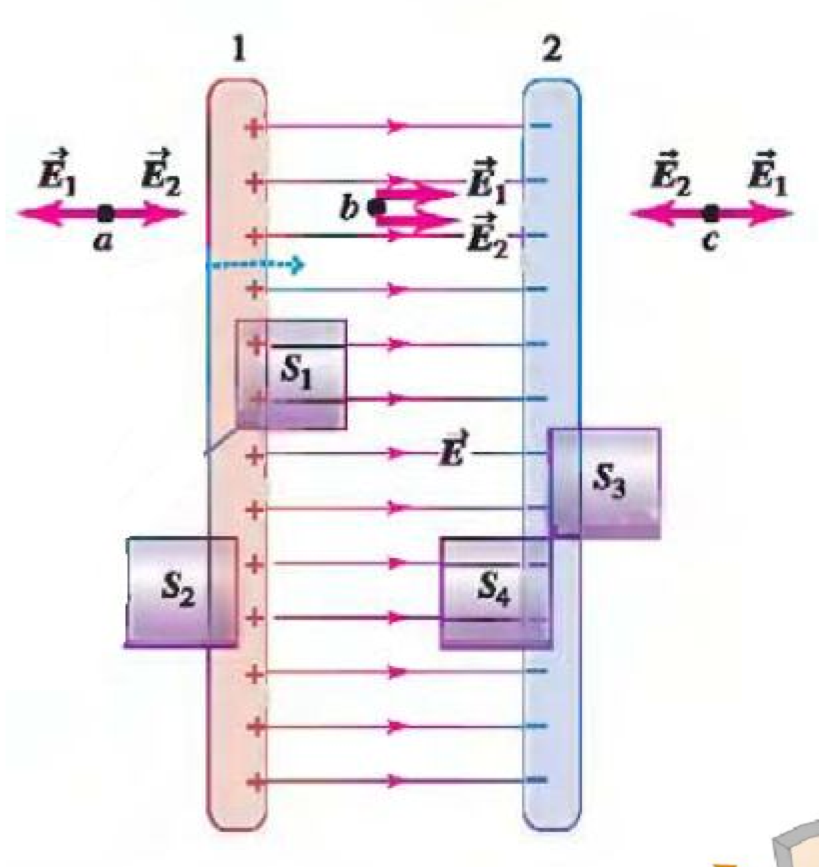
$$[C] = \frac{C}{V} = \frac{C^2}{J} = \frac{C^2}{N.m} = \text{Faradio} = F$$

$$\mu F = 10^{-6} F$$

$$pF = 10^{-12} F$$


+Q
-Q
Area = A
d
+
–

CAPACIDAD CONDENSADOR CARAS PARALELEAS



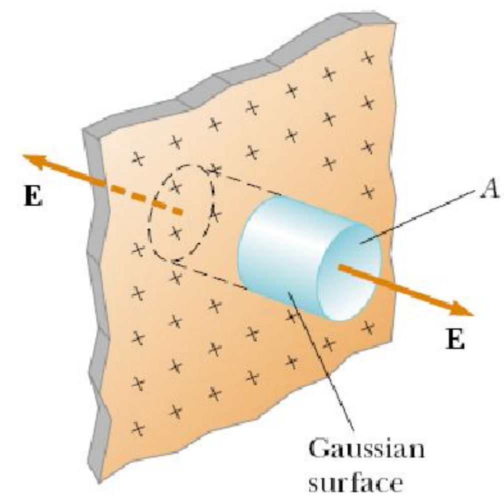
1)D<< dimensiones placas
 Placas infinitamente

2)Se desprecia efecto de borde

3) Problema con simetría

$$\vec{E}(x,y,z) = E(x)\hat{x}$$

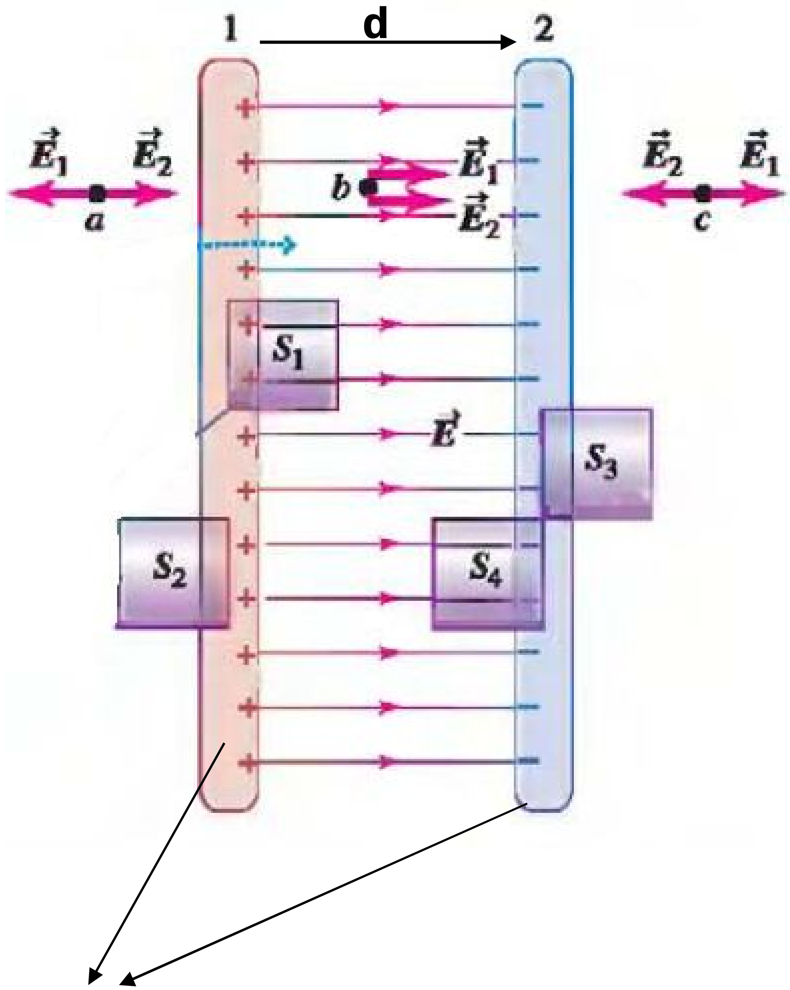
TEOREMA DE GAUSS



CAPACIDAD CONDENSADOR CARAS PARALELEAS

$$\sigma = \frac{q}{A} \qquad \sigma = -\frac{q}{A}$$

$$\phi_E = \oint\!\!\oint \vec{E}\,.d\vec{A} = \frac{Q_{enc}}{\varepsilon_0}$$



$E = 0$

S_1

$$\oint\!\!\oint \vec{E}.d\vec{A} = \iint_{base} \vec{E}.d\vec{A} + \iint_{tapa} \vec{E}.d\vec{A} + \iint_{lateral} \vec{E}.d\vec{A}$$

base → $\vec{E} = 0$

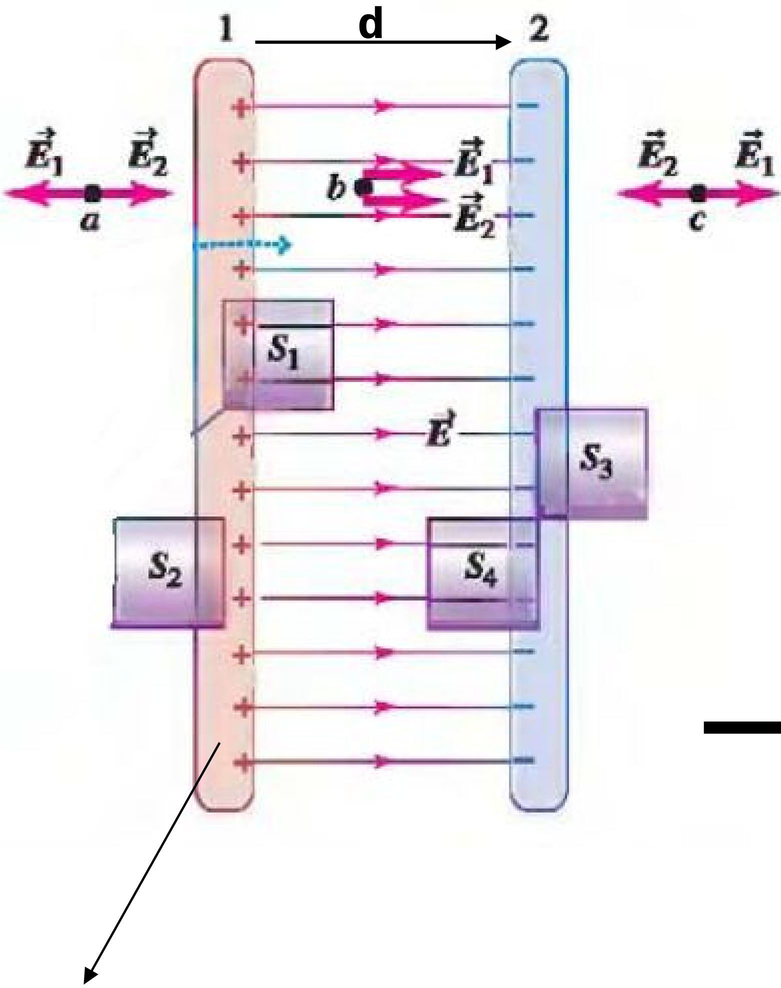
tapa → $\vec{E} \parallel d\vec{A}$

lateral → $\vec{E} \perp d\vec{A}$

$$\oint\!\!\oint \vec{E}.d\vec{A} = \iint_{lateral} E\,dA = E\,A = \frac{\sigma A}{\varepsilon_0}$$

$$E = \frac{\sigma}{\varepsilon_0}$$

$$\sigma = \frac{q}{A} \qquad \sigma = -\frac{q}{A}$$



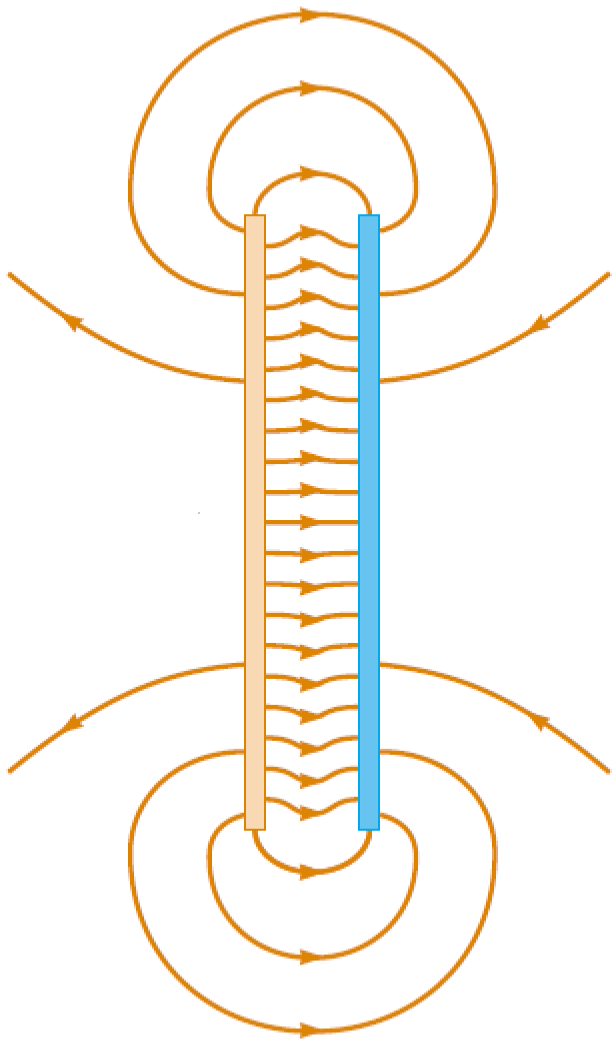
S₁

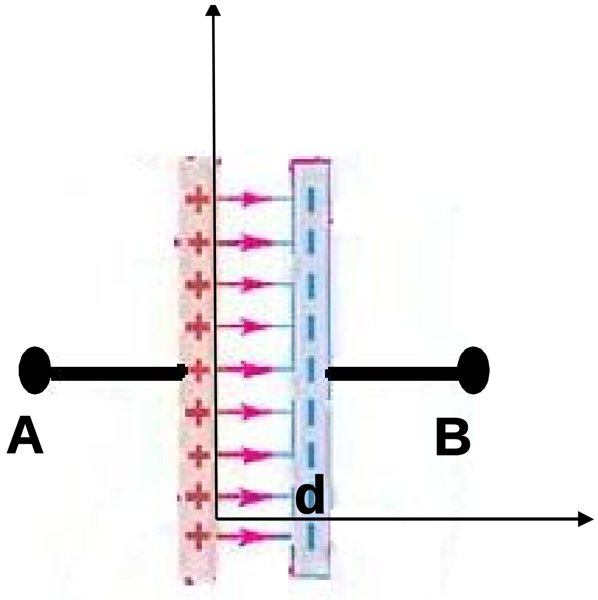
$$\oiint \vec{E}.d\vec{A} = \underbrace{\iint_{base} \vec{E}.d\vec{A}}_{\vec{E} /\!/ d\vec{A}} + \underbrace{\iint_{tapa} \vec{E}.d\vec{A}}_{\vec{E}=0} + \underbrace{\iint_{lateral} \vec{E}.d\vec{A}}_{\vec{E} \perp d\vec{A}}$$

$$\oiint \vec{E}.d\vec{A} = \iint_{lateral} E\,dA = E\,A = \frac{q_{enc}}{\varepsilon_0} = 0$$

$$\boxed{E = 0}$$

$$\longrightarrow \quad \boxed{\vec{E} = \begin{cases} \dfrac{\sigma}{\varepsilon_0}\hat{x} & 0 < x < d \\ 0 & \text{afuera} \end{cases}}$$

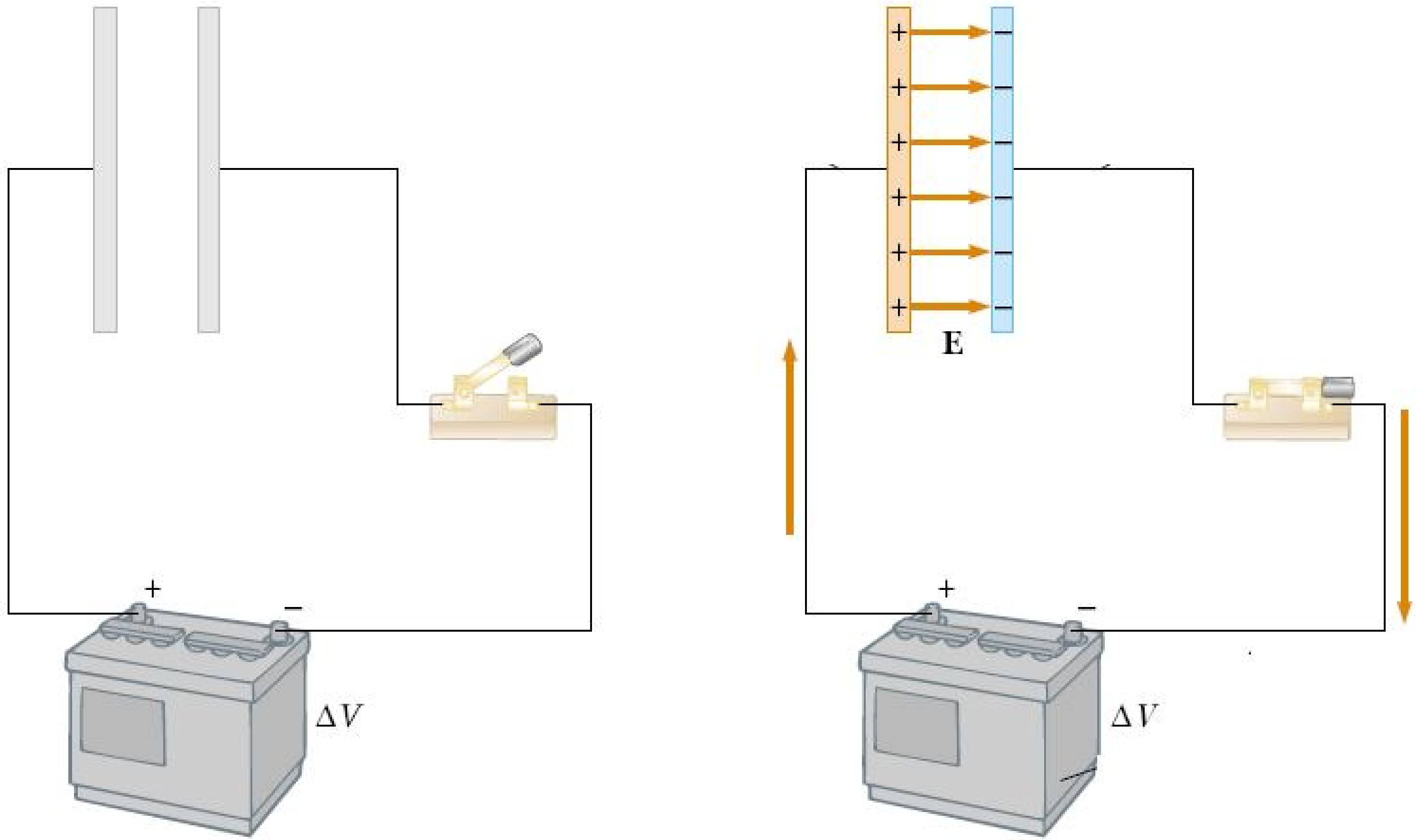




$$\Delta V = V_A - V_B = -\int_d^0 \vec{E}.d\vec{l}$$

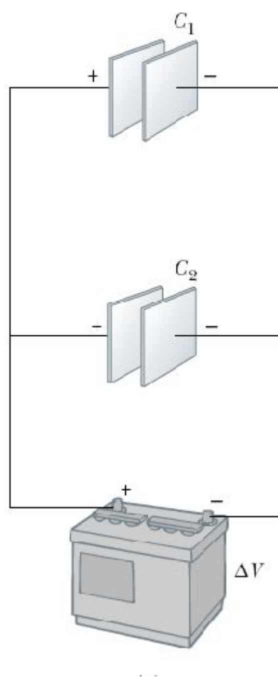
$$\Delta V = -\int_d^0 \frac{\sigma}{\varepsilon_0} dx = \frac{\sigma}{\varepsilon_0} d$$

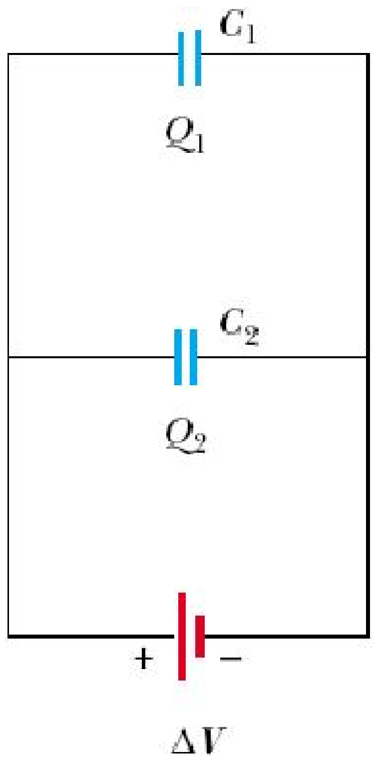
$$C = \frac{q}{\Delta V} = \frac{\sigma.A}{\Delta V} = \varepsilon_0 \frac{A}{d}$$

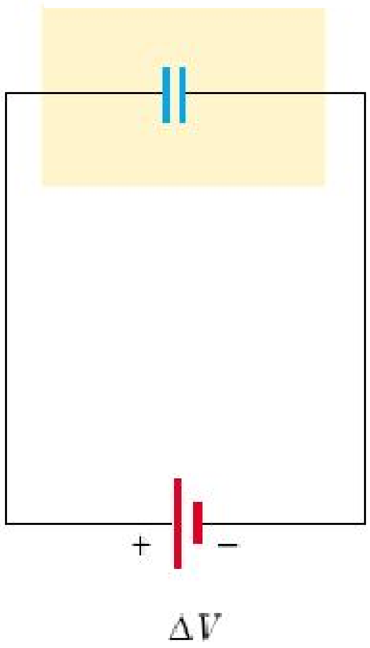


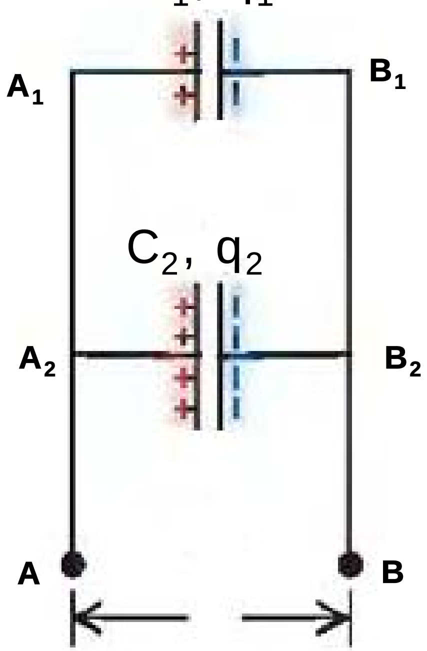
+
−
ΔV
+
+
+
+
+
+
−
−
−
−
−
−
E
+
−
ΔV

CAPACITORES EN PARALELO









$\Delta V = V_A - V_B$

Inicialmente ambos descargados

A, A_1, A_2 es una equipotencial $\longrightarrow$ $V_A = V_{A_1} = V_{A_2}$

B, B_1, B_2 es una equipotencial $\longrightarrow$ $V_B = V_{B_1} = V_{B_2}$

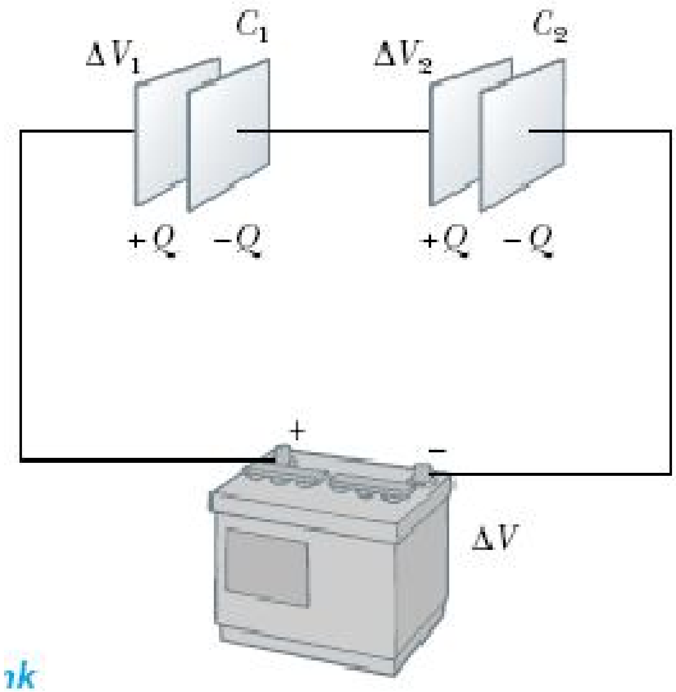
$$\left.\begin{array}{l} V_{A_1} - V_{B_1} = \Delta V = \dfrac{q_1}{C_1} \\ V_{A_2} - V_{B2} = \Delta V = \dfrac{q_2}{C_2} \end{array}\right\} \Delta V (C_1 + C_2) = q_1 + q_2 = q$$

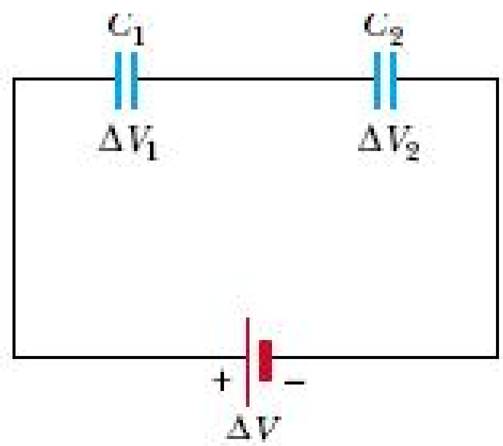
$$C_{eq} = C_1 + C_2$$

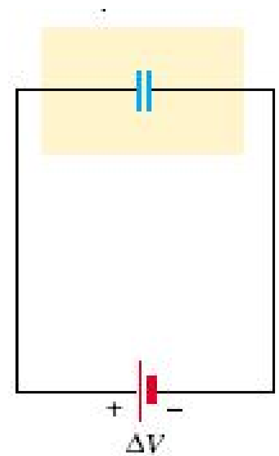
$$C_{eq} = \sum_i C_i$$

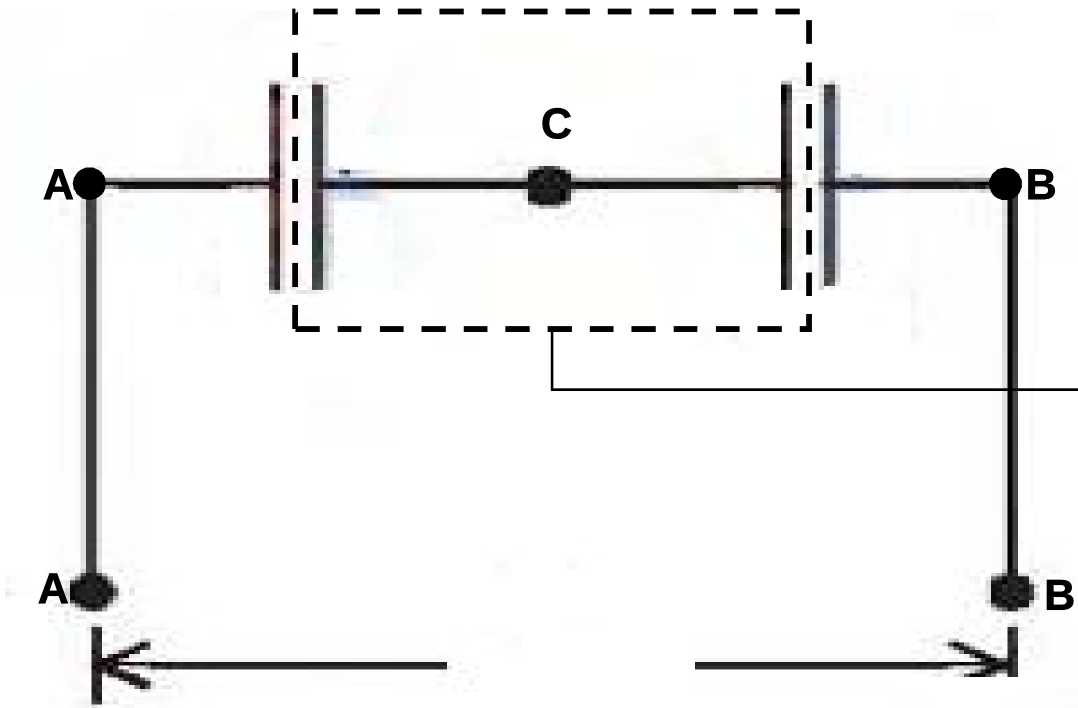
CAPACITORES EN SERIE

Inicialmente ambos descargados









$$\mathbf{q_{Ai}} = \mathbf{q_{Bi}} = 0$$

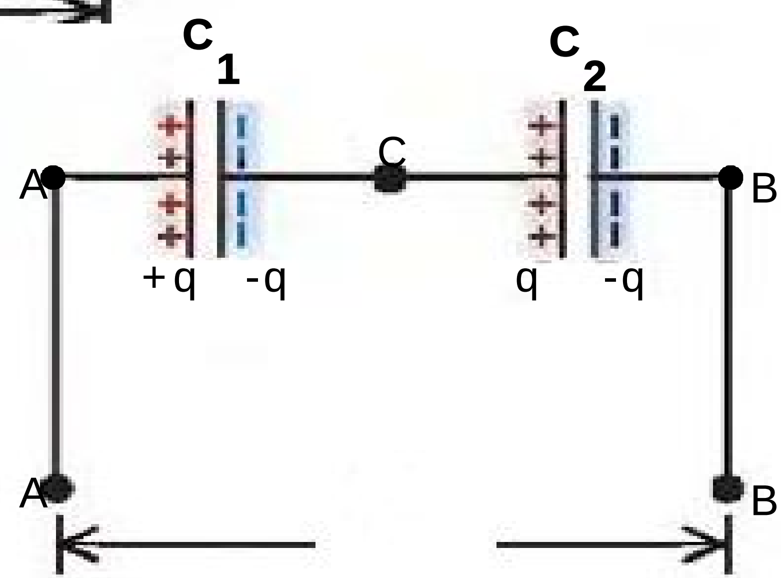
$$\mathbf{V_A} > \mathbf{V_B}$$

isla

$$\mathbf{q_{Ai}} + \mathbf{q_{Bi}} = 0$$

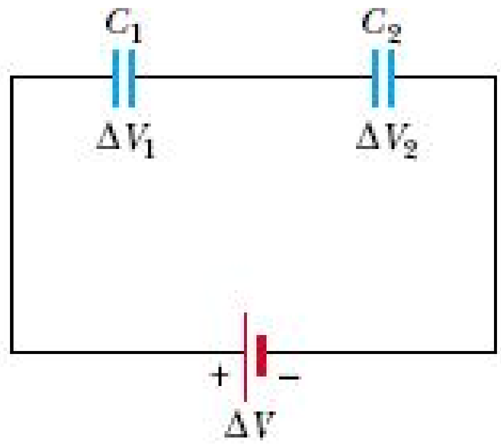
$$\mathbf{q_{Af}} + \mathbf{q_{Bf}} = 0$$

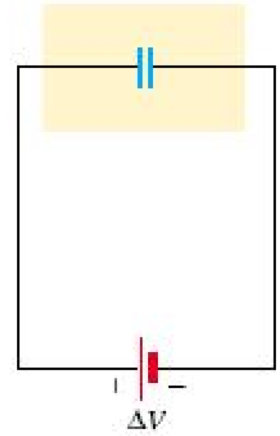
$$-\mathbf{q_{Af}} = \mathbf{q_{Bf}}$$



$$\mathbf{V_A} - \mathbf{V_B} = \mathbf{V_A} - \mathbf{V_C} + \mathbf{V_c} - \mathbf{V_B}$$

$$\mathbf{V_A} - \mathbf{V_B} = \frac{\mathbf{q}_1}{\mathbf{C}_1} + \frac{\mathbf{q}_2}{\mathbf{C}_2}$$





$$\mathbf{V_A - V_B = q}\left(\frac{1}{\mathbf{C}_1} + \frac{1}{\mathbf{C}_2}\right)$$

$$\frac{1}{\mathbf{C_{eq}}} = \sum_{\mathbf{i}} \frac{1}{\mathbf{C_i}}$$

ENERGÍA ALMACENADA EN UN CAPACITORES

$$\mathbf{V} = \mathbf{Q}/\mathbf{C}$$

Si inicialmente el capacitor descargados

Después de un dado tiempo **t** $$\mathbf{v} = \frac{\mathbf{q}}{\mathbf{C}}$$

W necesario para transferir un cantidad elemental de carga dq

$$\mathbf{dW} = -\mathbf{v}\ \mathbf{dq} = -\frac{\mathbf{q}}{\mathbf{C}}\mathbf{dq}$$

W necesario para incrementar la craga desde 0 hasta Q

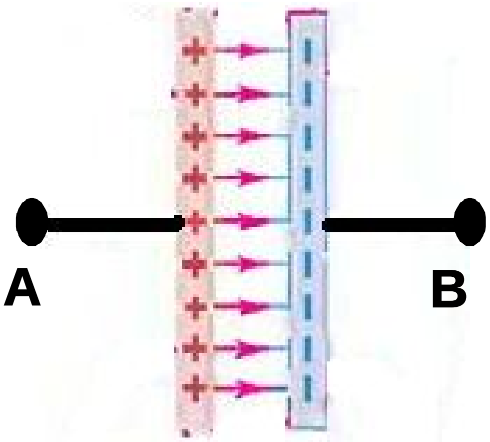
$$\mathbf{W} = -\int_0^{\mathbf{Q}} \frac{\mathbf{q}}{\mathbf{C}}\mathbf{dq} = -\frac{1}{2}\frac{\mathbf{Q}^2}{\mathbf{C}}$$

La energía almacenada en el capacitor

$$W = -\frac{Q^2}{2C}$$

$$U = \frac{Q^2}{2C} = \frac{1}{2}CV^2 = \frac{1}{2}QV$$

Suponiendo que el capacitor es un capacitor plano da caras paralelas



$$\Delta V = \frac{\sigma}{\varepsilon_0} d = E.d$$

$$C = \varepsilon_0 \frac{A}{d}$$

$$U = \frac{1}{2}\frac{\epsilon_0 A}{d}(E^2 d^2) = \frac{1}{2}(\epsilon_0 A d)E^2$$

$$u_E = \frac{1}{2}\epsilon_0 E^2$$