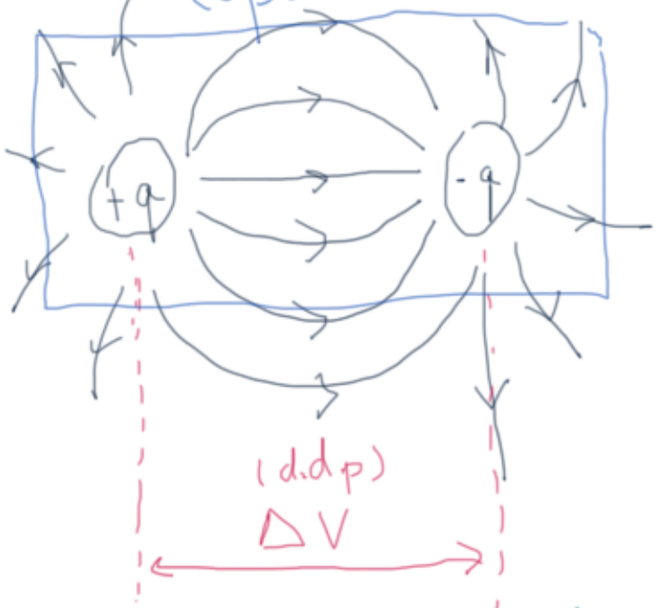
Capacitores

$$V_b - V_a = \Delta V = -\int_a^b \vec{E} \cdot d\vec{l}$$

Capacitor



símbolo

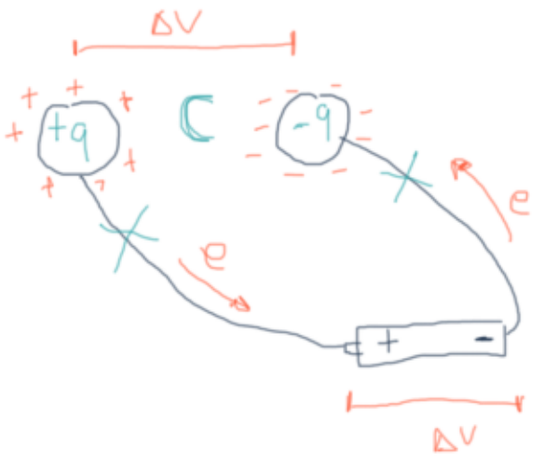
$q \propto \Delta V$

$q = C \cdot \Delta V$

$C = \frac{q}{\Delta V}$ = capacitância

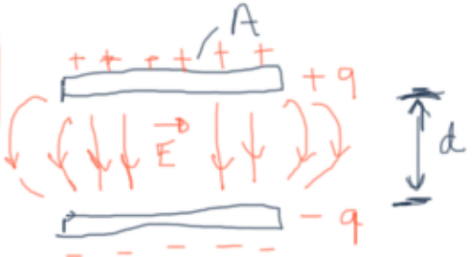
$[C] = \frac{\text{Coulomb}}{\text{volt}} = \text{farad} = F$

Processo de carregamento de um capacitor



Capacitores comuns

1) Placas planas/paralelas



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

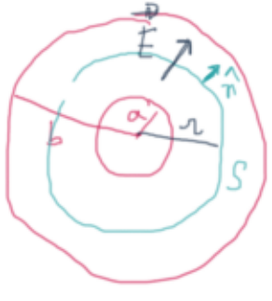
$\Delta V = E \cdot d$

$C = \frac{q}{\Delta V} = \frac{q}{E \cdot d} = \frac{q}{\frac{q}{\varepsilon_0 A} \cdot d}$

$= \frac{q}{\frac{qd}{\varepsilon_0 A}} = q \cdot \frac{\varepsilon_0 A}{qd} = \frac{\varepsilon_0 A}{d}$

$$C = \frac{\varepsilon_0 A}{d} = \varepsilon_0 \cdot \mathcal{L}$$

2) Capacitor cilíndrico



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

$$\oint_S \vec{E} \cdot \hat{n}\, dA = \frac{q_{int}}{\varepsilon_0}$$

$$\oint_S E\, dA = \frac{q}{\varepsilon_0}$$

$$E \underbrace{\oint_S dA}_{2\pi r L} = \frac{q}{\varepsilon_0}$$

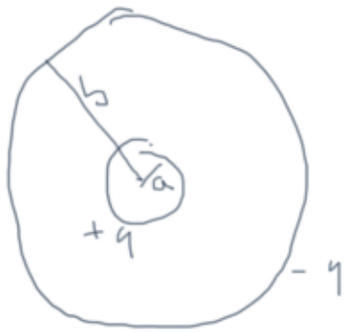
$$E = \frac{q}{2\pi r L \varepsilon_0}$$

$$\Delta V = \frac{q}{2\pi\varepsilon_0 L} \ln\left(\frac{b}{a}\right)$$

$$C = \frac{2\pi\varepsilon_0 L}{\ln\left(\frac{b}{a}\right)}$$

$$C = \varepsilon_0 \cdot \mathcal{L}$$

3) Capacitor esférico



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

$$\boxed{C = 4\pi\varepsilon_0 \frac{ab}{b-a}}$$

3a) Capacitância de uma esfera isolada

$$C = 4\pi\varepsilon_0 \frac{ab}{b-a}$$

$$= 4\pi\varepsilon_0 \frac{ab}{b\left(1-\frac{a}{b}\right)}$$

$$C = 4\pi\varepsilon_0 \frac{a}{1-\frac{a}{b}}$$

$$\lim_{b\to\infty} C = 4\pi\varepsilon_0 a$$

$$\boxed{C = 4\pi\varepsilon R}$$

Armazenamento de energia elétrica

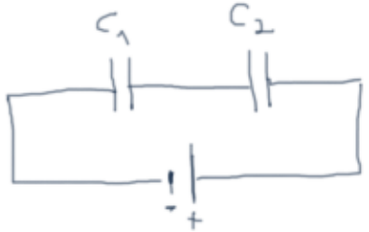
$$\boxed{U = \frac{1}{2} C \Delta V^2}$$

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

$$\boxed{U = \frac{1}{2} q \Delta V} \quad \text{ou} \quad \boxed{U = \frac{1}{2}\frac{q^2}{C}}$$

Associação de capacitores

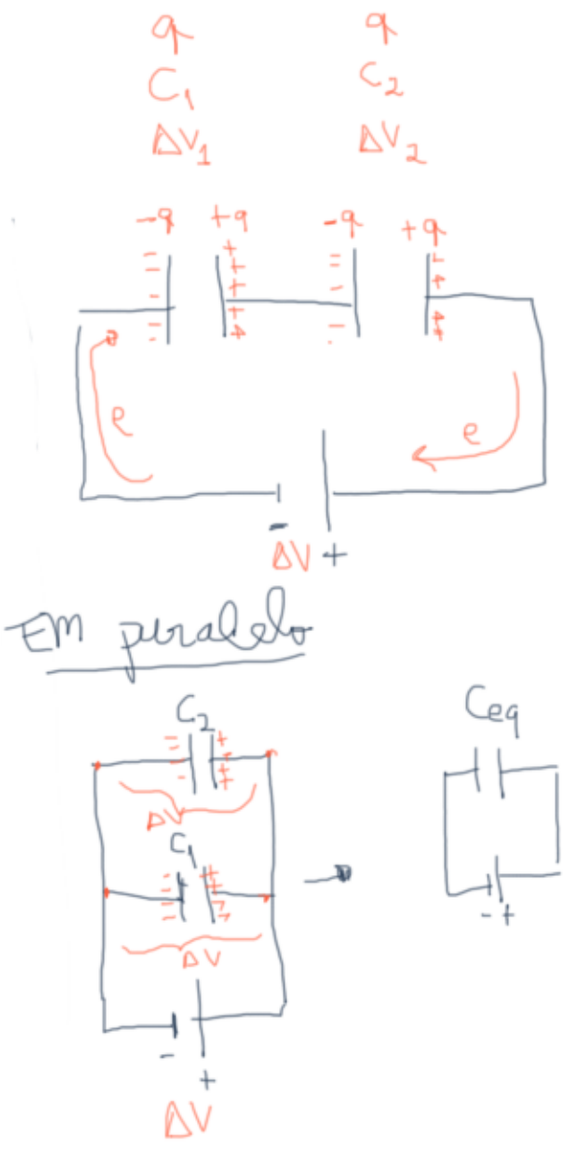
A) Em série



$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

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

B) Em paralelo



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

$$C_{eq} = \sum_{i=1}^{n} C_i$$

Energia

$$U = \frac{1}{2} C \cdot \Delta V^2$$

u = densidade volumétrica de energia

$$= \frac{U}{\text{Volume}}$$

$$u = \frac{1}{2} \varepsilon_0 E^2$$

24.1 , p.126

$C = 7,28\,\mu F = 7,28 \cdot 10^{-6}\,F$

$\Delta V = 25,0\,V$

$q = ?$

$C = \frac{q}{\Delta V} \rightarrow q = C \cdot \Delta V$

$q = 7,28 \cdot 10^{-6} \cdot 25,0$

$q = 182 \cdot 10^{-6}\,C$

ou

$q = 182\,\mu C$

24.2 , p.126

$A = 12,2\,cm^2 = 12,2\,(10^{-2}\,m)^2 = 12,2 \cdot 10^{-4}\,m^2$

$d = 3,28\,mm = 3,28 \cdot 10^{-3}\,m$

$q = 4,35 \cdot 10^{-8}\,C$

a) $C = ?$

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

$= \frac{8,85 \cdot 10^{-12} \cdot 12,2 \cdot 10^{-4}}{3,28 \cdot 10^{-3}}$

$C = 32,9 \cdot 10^{-13}\,F$

ou $C = 3,29\,pF$

$\varepsilon_0 = 8,85 \cdot 10^{-12}\,\frac{C^2}{N\,m^2}$

b) $\Delta V = ?$

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

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

$\Delta V = \frac{4,35 \cdot 10^{-8}}{32,9 \cdot 10^{-13}}$

$\Delta V = 0,132 \cdot 10^{5}\,V$

ou

$\Delta V = 13,2\,\underbrace{10^{3}\,V}_{K}$

$\Delta V = 13,2\,kV$

c) $E\,d = \Delta V$

$E = \frac{\Delta V}{d} = \frac{13,2 \cdot 10^{3}}{3,28 \cdot 10^{-3}} = 4,02 \cdot 10^{6}\,\frac{V}{m}$