Università degli Studi di Padova

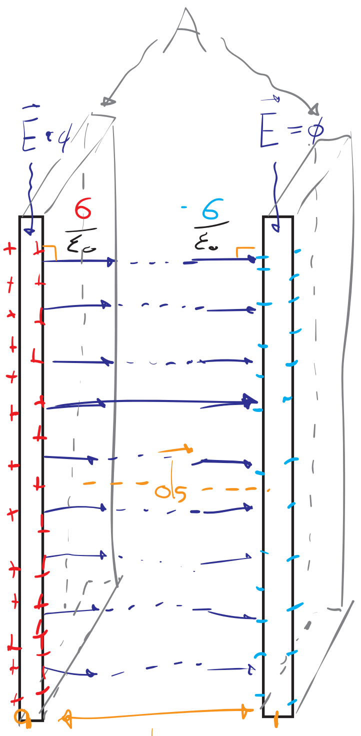
Fisica 1

Lezione 48: Capacità II

Prof. Giubilato

Università degli Studi di Padova

Condensatore piano

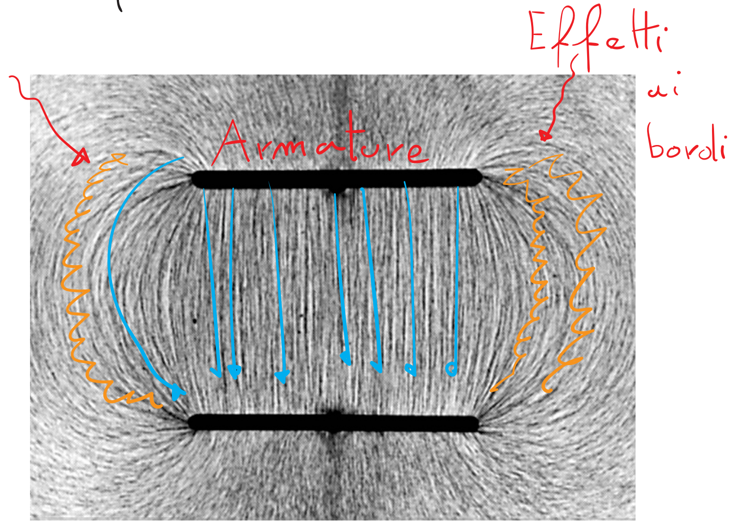


$\longleftarrow V \longrightarrow$

(ΔV)

$$\sigma = \frac{q}{2A}$$

$$\sigma = \frac{-q}{2A}$$



$$\vec{E}_{int} = \vec{E}_+ + \vec{E}_- = \frac{\sigma}{\varepsilon_0} + \frac{\sigma}{\varepsilon_0} = \frac{q}{2A\varepsilon_0} + \frac{q}{2A\varepsilon_0} = \frac{q}{A\varepsilon_0}$$

$$\vec{E}_{int} = \frac{q}{A\varepsilon_0}$$

$$V = -\int_0^d \vec{E}\cdot d\vec{s} = -\int_0^d \frac{q}{A\varepsilon_0}\,ds = -\frac{q}{A\varepsilon_0}\,d$$

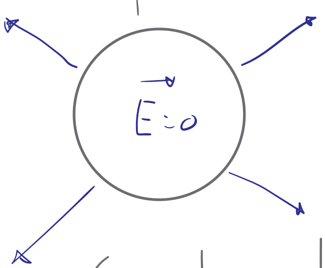
1

(-)

$$C = \frac{q^{(\pm)}}{V} = \frac{qA}{qd}\varepsilon_0 = \boxed{\frac{A}{d}\varepsilon_0}$$

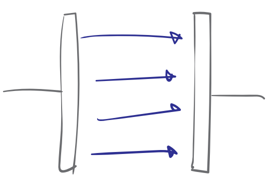
Capacità condensatore piano

Sfera

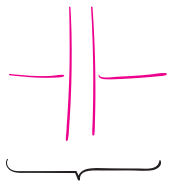


$$C = 4\pi\varepsilon_0 R$$

Condensatore piano



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



Simbolo

[F]

$1\,pF < \dots < \simeq \mu F$

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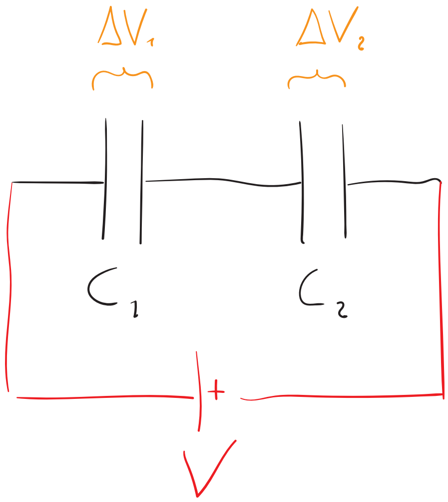
Condensatore



$$C_{TOT} = ?$$

$$\Delta V = V = V_1 + V_2 = \Delta V_1 + \Delta V_2$$

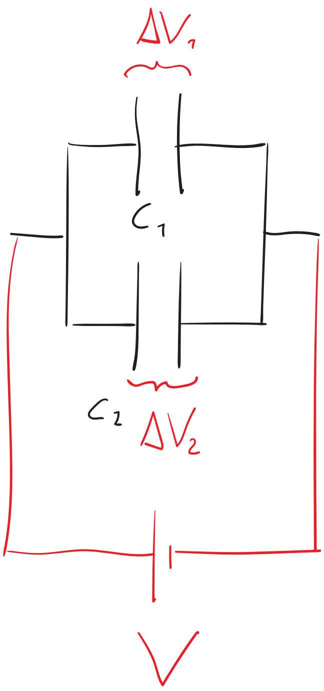
$$C_T = \frac{Q_T}{V}$$

$$\begin{cases} C_1 = \dfrac{Q_1}{V_1} \\ C_2 = \dfrac{Q_2}{V_2} \end{cases} \Rightarrow \begin{cases} Q_1 = C_1 V_1 = C_2 V_2 = Q_2 \\ C_T = \dfrac{Q}{V} = \dfrac{Q}{\dfrac{Q}{C_1} + \dfrac{Q}{C_2}} = \dfrac{C_1 C_2}{C_1 + C_2} \end{cases}$$

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2}$$

Serie di 2 capacitori

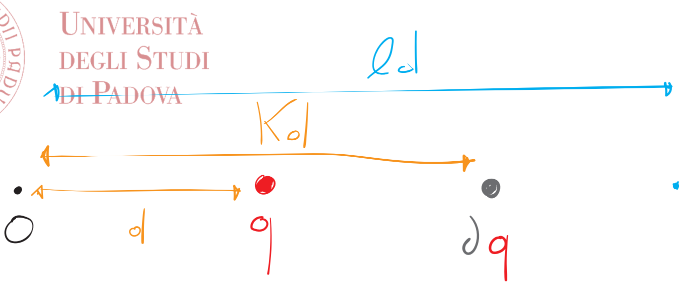
$$\underbrace{\frac{1}{C_T} = \sum_{i=1}^{n} \frac{1}{C_i}}_{\text{per } n \text{ capacitori}}$$



$$Q_T = Q_1 + Q_2 = C_1 V_1 + C_2 V_2 = V\,[C_1 + C_2]$$

Parallelo di condensatori

$$C_T = \sum_{i=1}^{n} C_i$$



$$\vec{E} = \phi$$

$$\vec{E}_T = \vec{E}_1 + \vec{E}_2 = \frac{q}{4\pi\varepsilon_0 (\ell d - d)^2} + \frac{Jq}{4\pi\varepsilon_0 (\ell d - Kd)^2}$$

$$= \frac{q}{4\pi\varepsilon_0}\left[\frac{1}{(\ell d - d)^2} + \frac{J}{(\ell d - Kd)^2}\right]$$

$$= \frac{q}{4\pi\varepsilon_0}\left[\frac{1}{d^2(\ell-1)^2} + \frac{J}{d^2(\ell-K)}\right] = \frac{q}{4\pi\varepsilon_0 d^2}\left[\frac{1}{(\ell-1)^2} + \frac{J}{(\ell-K)^2}\right]$$

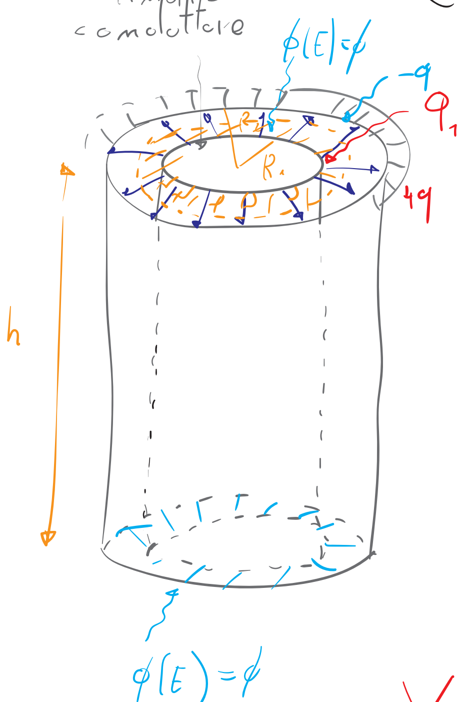
$$E = \phi \Rightarrow \left[\frac{1}{(\ell-1)^2} + \frac{J}{(\ell-K)^2}\right] \Rightarrow \frac{1}{(\ell-1)^2} = -\frac{J}{(\ell-K)^2}$$

$$J = -\frac{(\ell-K)^2}{(\ell-1)^2}$$

Cilindro conduttore

Capacità = ?

Gauss $\qquad V = -\int \vec{E}$



$$\left.\underbrace{R_2 - R_1}_{\text{piccolo}} \rightarrow \phi \right\} \text{ Effetti bordi trascurabili}$$

$$\sum_{Gauss} \quad \phi(\vec{E}) = E\, \overbrace{2\pi r h}^{\text{Superficie}} \underset{\text{Gauss}}{=} \frac{q}{\varepsilon_0} = \frac{\sigma\, 2\pi R_1 h}{\varepsilon_0}$$

$$\underset{\phi}{=} E = \frac{\sigma R_1}{\varepsilon_0 r} = \frac{\sigma}{\varepsilon_0} R_1 \frac{1}{r}$$

$$V = -\int_{R_1}^{R_2} E(r)\,dr = -\int_{R_1}^{R_2} \frac{\sigma R_1}{\varepsilon_0 r}\,dr = -\frac{\sigma R_1}{\varepsilon_0}\left[\ln r\right]_{R_1}^{R_2} = \frac{\sigma R_1}{\varepsilon_0} \ln \frac{R_2}{R_1}$$

$$V = -\frac{\sigma R_1}{\varepsilon_0} \ln \frac{R_2}{R_1}$$

$$q = \sigma\, 2\pi R_1 h$$

$$C = \frac{q}{V} = \frac{\cancel{\sigma}\, 2\pi \cancel{R_1} h}{-\frac{\cancel{\sigma} \cancel{R_1}}{\varepsilon_0} \ln \frac{R_2}{R_1}} = -\frac{2\pi \varepsilon_0 h}{\ln R_2/R_1}$$

solo geometria