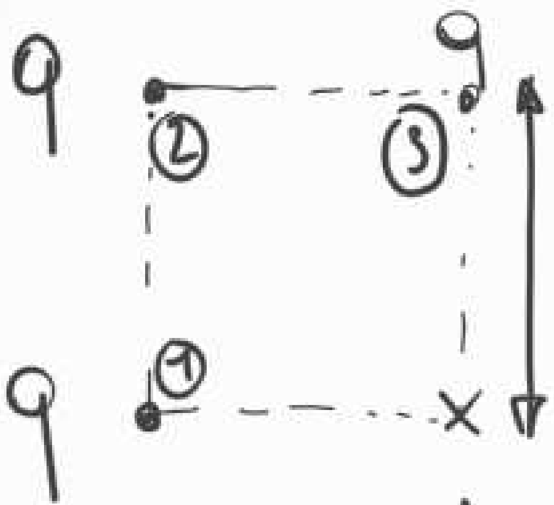


1) $U_e = ?$

2) q_0 nel $\underline{IV}$ vertice, $W = ?$, $W_{ext} = ?$

$$U_e = \frac{1}{4\pi\varepsilon_0}\sum_{i>j}\frac{q_i q_j}{r_{ij}} = \frac{q^2}{4\pi\varepsilon_0}\left(\frac{1}{r_{12}}+\frac{1}{r_{13}}+\frac{1}{r_{23}}\right) =$$

$$= \frac{q^2}{4\pi\varepsilon_0}\left(\underbrace{\frac{1}{L}}_{U_{12}} + \underbrace{\frac{1}{\sqrt{2}\,L}}_{U_{13}} + \underbrace{\frac{1}{L}}_{U_{23}}\right)$$

$q \quad \cdot^{(2)} \qquad {}^{(3)}\cdot \quad q \qquad \underline{W \ , \ W_{ext}}$

$q \quad \cdot^{(1)} \qquad {}^{(4)}\cdot \quad q_0 \qquad W = -\Delta U_e = -W_{ext}$

$$\Delta U = U_f - U_i \ , \quad \Delta U_e = U_e^{(4)} - U_e^{(3)}$$

$$U_e' = \sum_{i>j} \frac{q_i q_j}{4\pi\varepsilon_0} \frac{1}{r_{ij}} = U_e^{(3)} + U_e^{(14)} + U_e^{(24)} + U_e^{(34)} \Rightarrow$$

$$\Delta U_e = U_e^{(14)} + U_e^{(24)} + U_e^{(34)} = \frac{q_0 q}{4\pi\varepsilon_0}\left(\frac{1}{L} + \frac{1}{L} + \frac{1}{\sqrt{2}L}\right) \Rightarrow$$

$$W = -\Delta U_e = -\frac{q q_0}{\boxed{4\pi\varepsilon_0}}\boxed{\left(\frac{2}{L}+\frac{1}{\sqrt{2}L}\right)} \begin{array}{l} >0 \\ >0 \end{array}$$

$q q_0 > 0 \Rightarrow W < 0$ $\qquad \vec{F}\cdot d\vec{s} < 0 \Rightarrow \Delta U_e > 0$

$q q_0 < 0 \Rightarrow W > 0$ $\qquad \vec{F}\cdot d\vec{s} > 0 \Rightarrow \Delta U_e < 0$

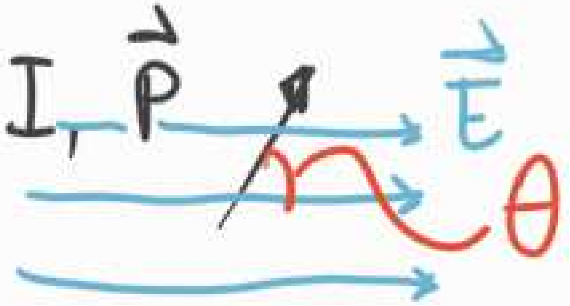
$q q_0 > 0 \Rightarrow W_{ext} > 0$

$q q_0 < 0 \Rightarrow W_{ext} < 0$

$\underline{\text{III}}$ W: $q = 2\cdot 10^{-7}\,C$

$q_0 = -10^{-8}\,C$

$L = 5\,cm$



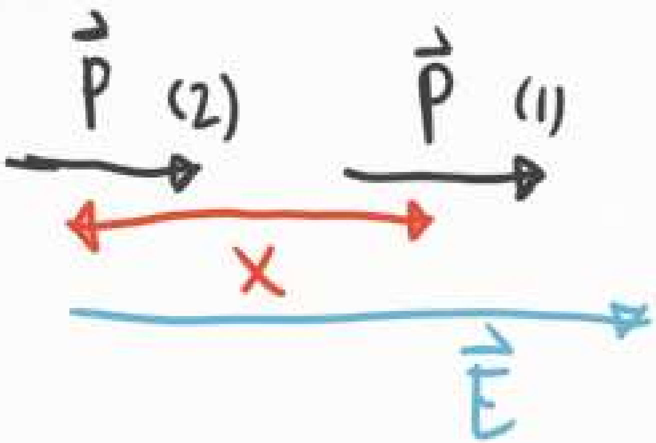
1) $\omega = ?$ quando $\theta = 0$, $U_e = -\vec{p} \cdot \vec{E}$

$$U_e^{(i)} = -p\bar{E}\cos\theta = U_{TOT}^{(i)}$$

$$U_{TOT}^{(f)} = -pE + \boxed{\frac{1}{2} I \omega^2} = U_{TOT}^{(i)} = -p\bar{E}\cos\theta \Rightarrow$$

$$\omega = \sqrt{\frac{2pE(1-\cos\theta)}{I}}$$

$$\boxed{I\ddot{\theta} = pE\sin\theta}$$



2) $U_e = ?$

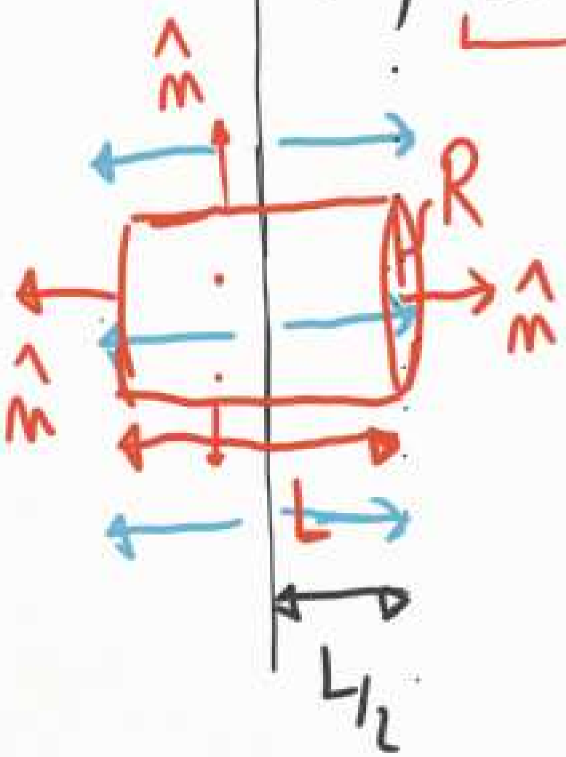
$$U_e^{(1)} = -\vec{p}\cdot\vec{E}_{TOT} = -\vec{p}\cdot\left(\vec{E}+\vec{E}_d\right) =$$

$$= -p\left(E+E_d\right)$$

$$E_d(x) = \frac{p}{2\pi\varepsilon_0}\frac{1}{x^3} \Rightarrow U_e^{(1)} = -pE \boxed{-\frac{p^2}{2\pi\varepsilon_0}\frac{1}{x^3}}$$

$$U_e = -pE - pE - \frac{p^2}{2\pi\varepsilon_0}\frac{1}{x^3}$$

σ, $E(x) = ?$



$$\int_\Sigma \vec{E} \cdot \hat{n}\, d\Sigma = \frac{Q_\Sigma}{\varepsilon_0}$$

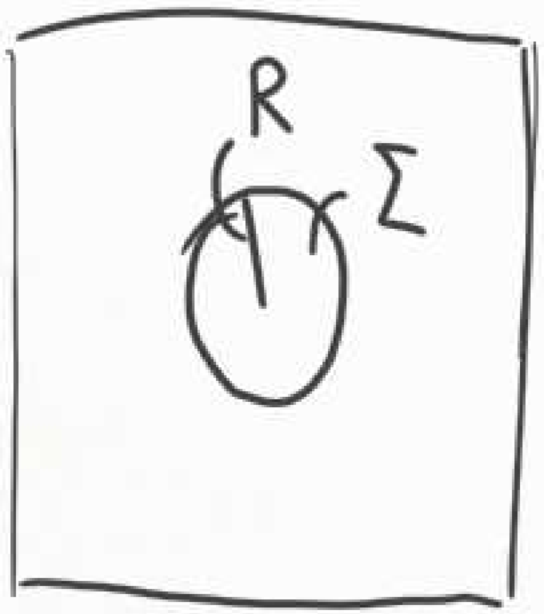
$$\int_\Sigma \vec{E} \cdot \hat{n}\, d\Sigma = \int_{B_1} \vec{E} \cdot \hat{n}\, d\Sigma + \int_{B_2} \vec{E} \cdot \hat{n}\, d\Sigma + \cancel{\int_{\Sigma_L} \vec{E} \cdot \hat{n}\, d\Sigma} =$$

$$= E \int_{B_1} d\Sigma + E \int_{B_2} d\Sigma = E\, 2\pi R^2 = \frac{Q_\Sigma}{\varepsilon_0}$$

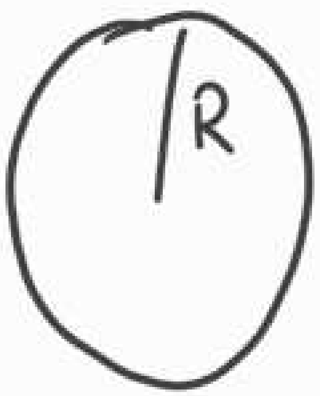
$$Q_\Sigma = \int_{\tau_\Sigma} dq = \int_\Sigma \sigma\, d\Sigma = \sigma \int_\Sigma d\Sigma$$

PROX PAGINA

$$Q_\Sigma = \int_{\tau_\Sigma} dq = \int_\Sigma \sigma \, d\Sigma = \sigma \int_\Sigma d\Sigma = \sigma \pi R^2 \Rightarrow$$



$$2\cancel{\pi R^2} E = \frac{\sigma \cancel{\pi R^2}}{\varepsilon_0} \Rightarrow E = \frac{\sigma}{2\varepsilon_0}$$



$E(r) = ?$ 1) q è distribuita superficialmente, σ

2) q " " nel volume, ρ

---

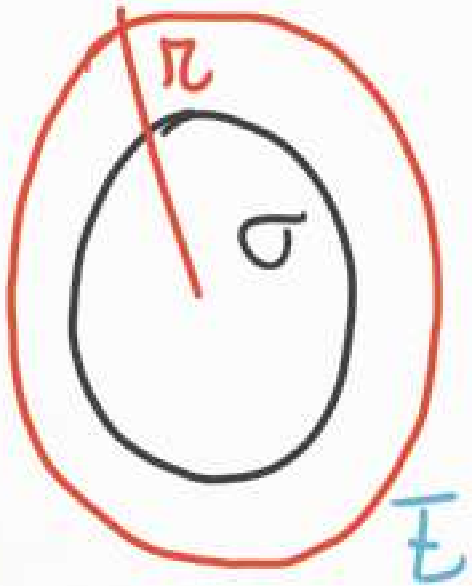
1) σ

$E(r)$ per $r<R$

$$\int_\Sigma \vec{E}(r)\cdot\hat{n}\,d\Sigma = \int_\Sigma E(r)\,d\Sigma = E(r)\int_\Sigma d\Sigma = E(r)\,4\pi r^2$$

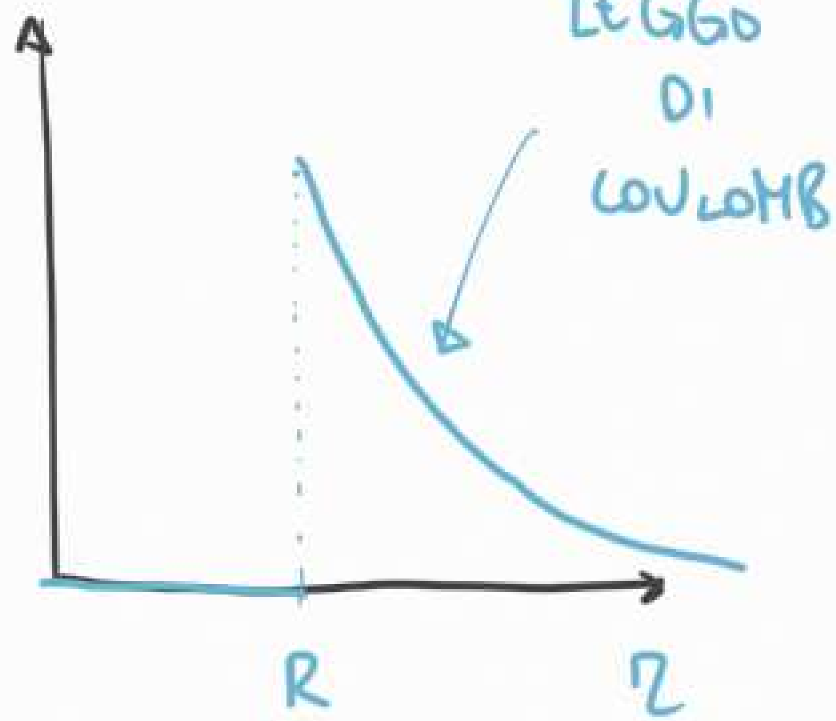
$$Q_\Sigma = 0 \Rightarrow E(r) = 0$$

$E(r) > R$



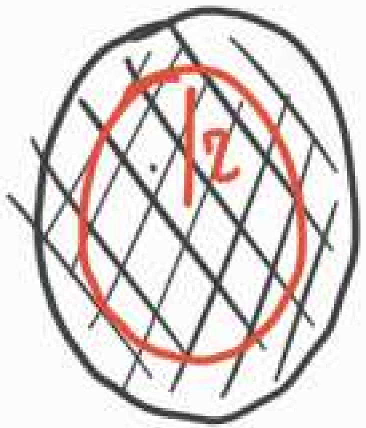
$$\oint_\Sigma \vec{E}(r)\cdot\hat{n}\, d\Sigma = E(r)\,4\pi r^2 \,, \quad Q_\Sigma = \sigma\, 4\pi R^2 = q$$

$$\Rightarrow E(r) = \frac{q}{4\pi\varepsilon_0}\frac{1}{r^2} = \frac{\sigma\, 4\pi R^2}{4\pi\varepsilon_0}\frac{1}{r^2}$$



$\underline{II}$ ρ , $\boxed{dq = \rho\, d\tau}$

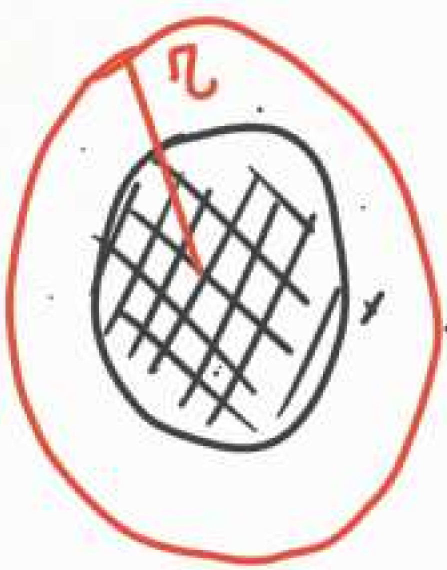
$r < R$



$$E(r)\, 4\pi r^2 = \frac{Q_\Sigma}{\varepsilon_0} \quad , \quad Q_\Sigma = \int_{\tau_\Sigma} \rho\, d\tau = \rho \int_{\tau_\Sigma} d\tau = \frac{4}{3}\pi \rho r^3$$

$$\Rightarrow E(r) = \frac{\rho}{3\varepsilon_0} r$$

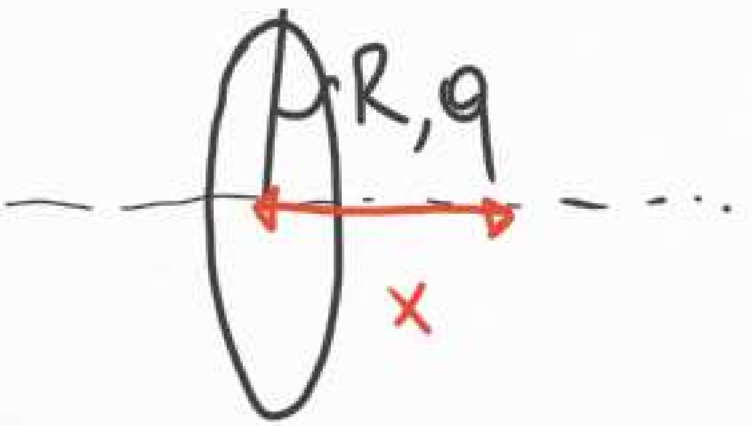
$r > R$



$$E(r)\, 4\pi r^2 = \frac{Q_\Sigma}{\varepsilon_0} \quad , \quad Q_\Sigma = \int_{\tau_\Sigma} \rho\, d\tau = \frac{4}{3}\pi \rho R^3 = q \Rightarrow$$

$$\boxed{E(r) = \frac{q}{4\pi\varepsilon_0} \frac{1}{r^2}}$$

3) $\rho(r) = Ar^2$, $r < R$



1) $V(x) = ?$

2) $V(x) \to \vec{E}(x,0,0)$

ESEMPIO 2.6 (MNV)

SOLUZIONI SUL SITO