Lezione # 17

9/4/2023

ELETTROSTATICA $(\vec{N}=\vec{0})$

MATERIALI: → ISOLANTI

↳ IL PASSAGGIO DI CARICA ELETTRICA MOLTO DIFFICILE (Vetro; plastica; legno)

→ CONDUTTORI

↳ offrono una scarsa "resistenza" al passaggio di carica elettrica (Rame, leghe metalliche)

→ SUPER CONDUTTORI

↳ "Teoricamente" offrono una resistenza nulla al passaggio di carica

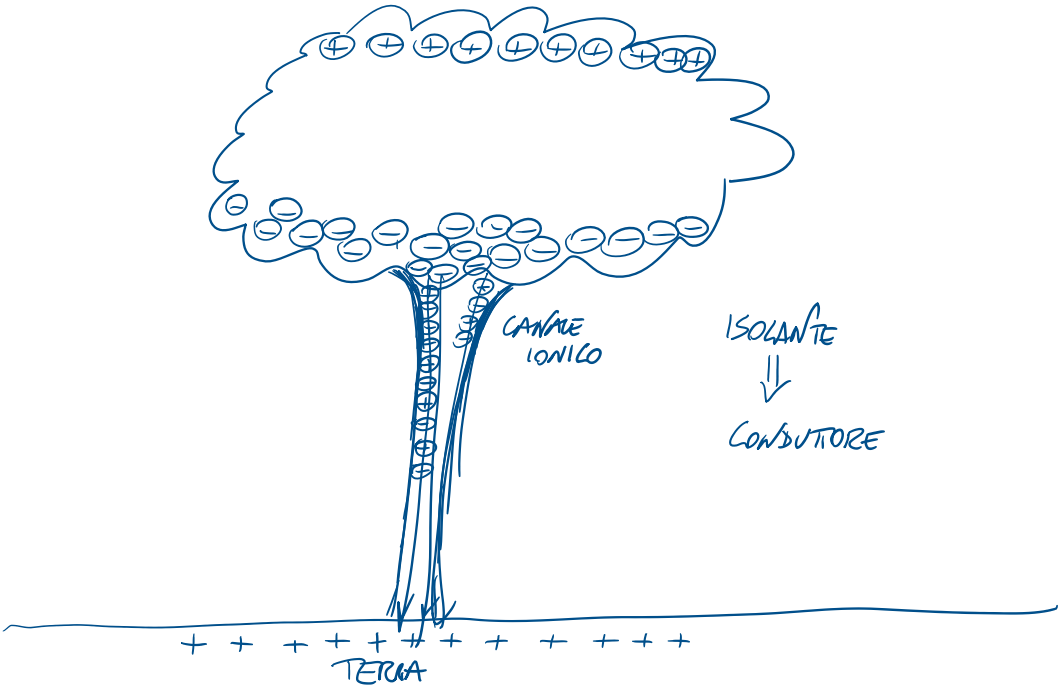
→ SEMI CONDUTTORI

↳ { CONDUTTORE / ISOLANTE } ↳ "Silicio"

ESEMPIO

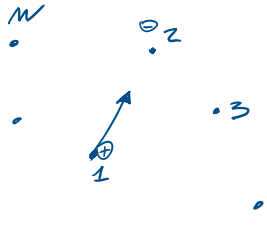
ACCUMULO CARICA ELETTROSTATICA

FULMINE



$$F_{12} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_1}{r_{12}^2}$$

Quando abbiamo un sistema di n cariche puntiformi



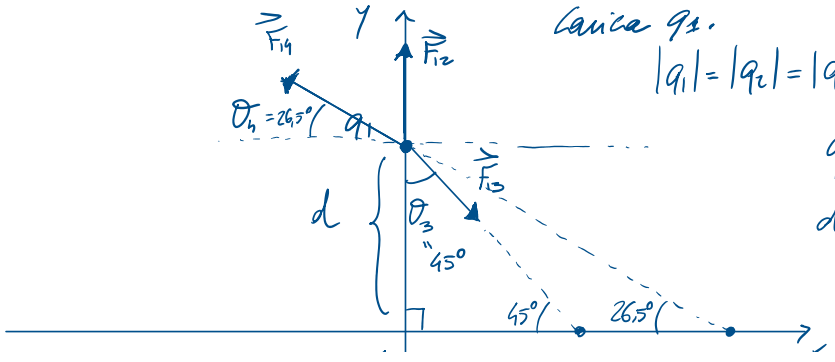
$$\vec{F}_1 = \vec{F}_{12} + \vec{F}_{13} + \dots + \vec{F}_{1n}$$

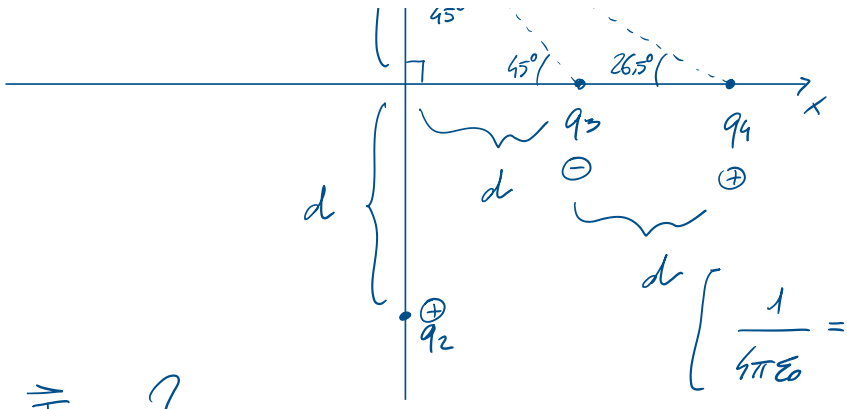
Esercizio: Date le 4 cariche riportate in figura, calcolare F_{13} e la risultante delle forze agenti sulla carica q_1.

$$|q_1| = |q_2| = |q_3| = |q_4| = q$$

$$q = 1{,}6\ 10^{-19}\ C$$

$$d = 1\ m$$





$\left[\frac{1}{4\pi\varepsilon_0} = 8{,}9\ 10^9\ \frac{N m^2}{C^2} \right]$

1) $\vec{F}_{13} = ?$

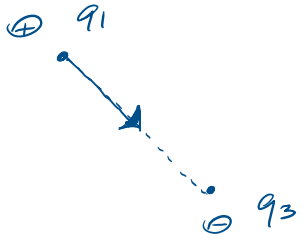
$$F_{13} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_3}{r_{13}^2}$$

$$r_{13} = \sqrt{1^2 + 1^2} = \sqrt{2}$$

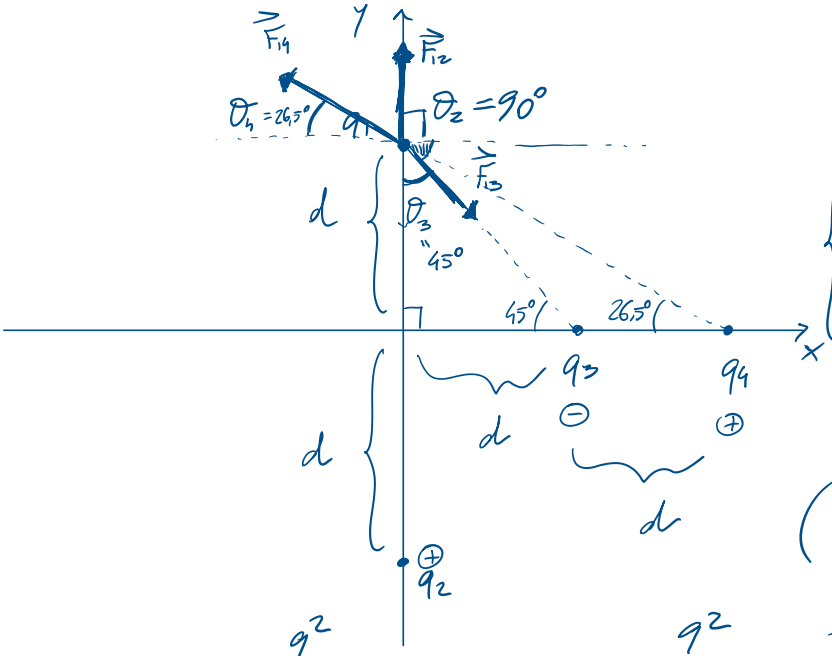
$$r_{13}^2 = 2$$

$$= 8{,}9\ 10^9 \ \frac{1{,}6\ 10^{-19} \cdot 1{,}6\ 10^{-15}}{2} = 11{,}39\ 10^{-25}\ N$$

$$\boxed{F_{13} = 11{,}39\ 10^{-25}\ N}$$



2) Calcolare la risultante delle forze agenti sulla carica q_1.



$$\vec{F}_1^{RIS} = \vec{F}_{12} + \vec{F}_{13} + \vec{F}_{14}$$

$$\begin{cases} F_{1x} = 0 + F_{13}\cos\vartheta_3' - F_{14}\cos\vartheta_4 \\ F_{1y} = F_{12} - F_{13}\sin\vartheta_3' + F_{14}\sin\vartheta_4 \end{cases}$$

$$\left(\vartheta_3' = 90 - \vartheta_3 = 45°\right)$$

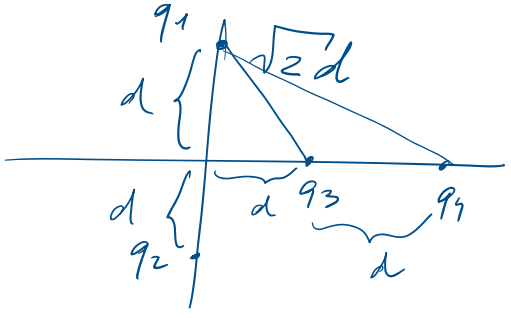
$$|q_1| = |q_2| = |q_3| = |q_4| = q$$

$$F_{1x} = \left[\frac{1}{4\pi\varepsilon_0}\frac{q\cdot q_3}{r_{13}^2}\cos\vartheta_3' - \frac{1}{4\pi\varepsilon_0}\frac{q\cdot q_4}{r_{14}^2}\cos\vartheta_4\right]$$

$$F_{1y} = \left[\frac{1}{4\pi\varepsilon_0}\frac{q\cdot q_2}{r_{12}^2} - \frac{1}{4\pi\varepsilon_0}\frac{q\cdot q_3}{r_{13}^2}\sin\vartheta_3' + \frac{1}{4\pi\varepsilon_0}\frac{q\cdot q_4}{r_{14}^2}\sin\vartheta_4\right]$$

$$\begin{cases} F_{1x} = \dfrac{1}{4\pi\varepsilon_0}\cdot q^2\left(\dfrac{1}{r_{13}^2}\cos\vartheta_3' - \dfrac{1}{r_{14}^2}\cos\vartheta_4\right) \\ F_{1y} = \dfrac{1}{4\pi\varepsilon_0}\cdot q^2\left(\dfrac{1}{r_{12}^2} - \dfrac{1}{r_{13}^2}\sin\vartheta_3' + \dfrac{1}{r_{14}^2}\sin\vartheta_4\right) \end{cases}$$

$$\begin{cases} r_{12} = 2d \\ r_{13} = \sqrt{2}\,d \\ r_{14} = \sqrt{5}\,d \end{cases}$$



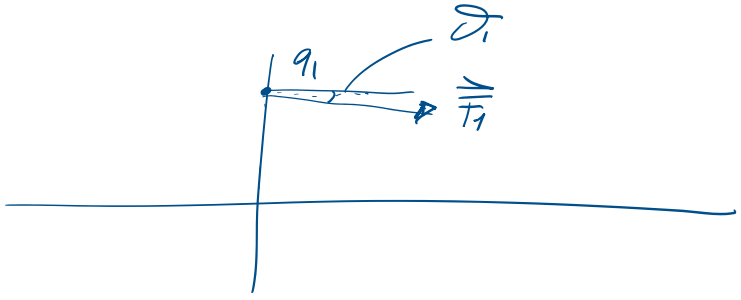
$$r_{14} = \sqrt{d^2 + (2d)^2}$$

$$r_{14} = \sqrt{5}\, d$$

$$\begin{cases} F_{1x} = \dfrac{1}{4\pi\varepsilon_0}\dfrac{q^2}{d^2}\left(\dfrac{1}{2d^2}\cos\vartheta_3' - \dfrac{1}{5d^2}\cos\vartheta_4'\right) \\ F_{1y} = \dfrac{1}{4\pi\varepsilon_0 d^2} q^2\left(\dfrac{1}{2d^2} - \dfrac{1}{2d^2}\sin\vartheta_3' + \dfrac{1}{5d^2}\sin\vartheta_4'\right) \end{cases}$$

$$\begin{cases} F_{1x} = 3{,}97\ 10^{-29}\ N \\ F_{1y} = -3{,}54\ 10^{-30}\ N \end{cases}$$

$$|\vec{F}_1| = \sqrt{F_{1x}^2 + F_{1y}^2} = 3{,}98\ 10^{-29}\ N$$

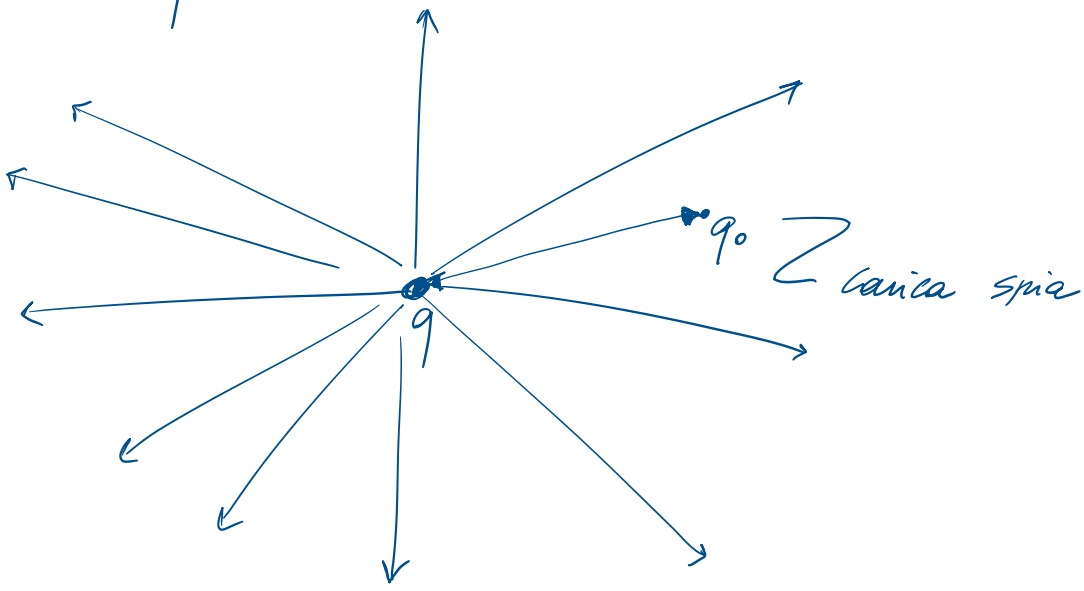


$$\vartheta_1 = \arctg\left(\frac{-3{,}54\ 10^{-30}}{3{,}97\ 10^{-29}}\right) = -5{,}09°$$

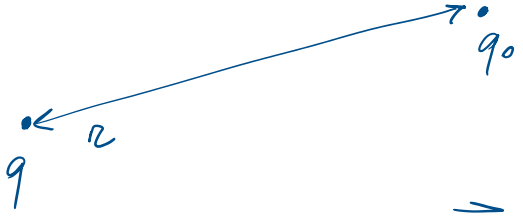
CAMPO ELETTRICO

$$\vec{E} = \frac{\vec{F}_c}{q}$$

come faccio a calcolarlo?



$q_0 \ll q$ $\Rightarrow$ il campo elettrico di q_0 posso ragionevolmente considerarlo trascurabile $\not\Rightarrow \vec{E} + \vec{E}_0$



$$\vec{E} = \frac{\vec{F}_c}{q_0} = \frac{1}{4\pi\varepsilon_0} \frac{q q_0}{r^2} \frac{1}{q_0}$$

Campo elettrico a

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

Campo elettrico a dovuto alla presenza di una carica puntiforme a distanza r

$$[E] = \frac{N}{C}$$ ✓