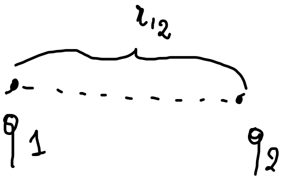
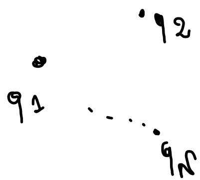
Legge di Coulomb



$$\underline{F} = k_{el} \frac{q_1 q_2}{r_{12}^2} \hat{\underline{r}}_{12}$$

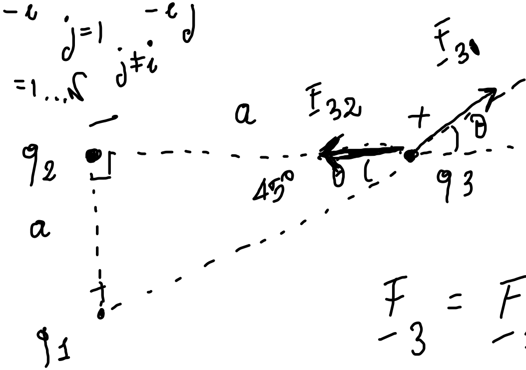
Valori tipici:
nC mC
μC
$e = 1.6 \cdot 10^{-19}$ C



$$\underline{F}_i = \sum_{\substack{j=1 \\ j \neq i}}^{N} \underline{F}_{ij}$$

$i = 1 \ldots N$

es 23.2

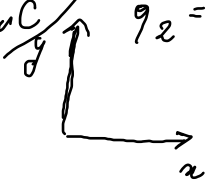


$a = 0.1$ m

$q_1 = q_3 = 5\,\mu C$ $\quad q_2 = -2\,\mu C$

$\vec{F}_3 = ?$

$\underline{F}_3 = \underline{F}_{31} + \underline{F}_{32}$



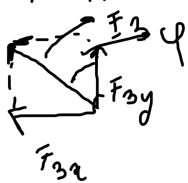
$F_{31x} = F_{31}\cos\theta$ $\qquad$ $F_{31y} = F_{31}\sin\theta$ $\qquad$ $\cos\theta = \frac{\sqrt{2}}{2}$ $\qquad$ $\sin\theta = \sqrt{2}/2$

$F_{32x} = -F_{32}$ $\qquad$ $F_{32y} = 0$

$$F_{31} = K_e \frac{q_1 q_3}{d_{31}^2} \simeq 11.2N \quad \left[d_{31}^2 = a^2 + a^2 = 2a^2\right]$$

$$F_{32} = K_e \frac{q_1 q_2}{d_{32}^2} = K_e \frac{q_1 q_2}{a^2} \simeq 9N \quad \left[d_{32} = a\right]$$

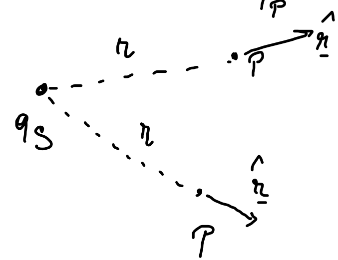
$F_{3x} = F_{31x} + F_{32x} = -1.04N$ $\qquad$ $F_{3y} = 7.94N$



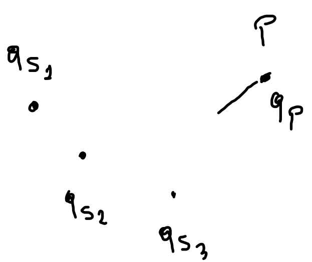
$$F_3 = \sqrt{F_{3x}^2 + F_{3y}^2} \qquad \cos\varphi = F_{3y}/F_3$$

Campo elettrico

$$\underline{E}(P) = \frac{\underline{F}_{Coul}(q_P)}{q_P} = \frac{K_e \dfrac{q_S \cancel{q_P}}{r^2}\,\hat{\underline{r}}}{\cancel{q_P}}$$



$$= \frac{K_e q_S}{r^2}\,\hat{\underline{r}}$$



$$\underline{F}_{Coul}(q_P) = \sum_{i = s_1, s_2 \dots} \underline{F}_i(q_P)$$

$$\underline{E}(P) = \frac{\underline{F}_{Coul}(q_P)}{q_P} = \sum_{s_1, s_2, \dots} \overbrace{\frac{\underline{F}_i(q_0)}{q_0}}^{\underline{E}_i} = \sum_{i=1} \underline{E}_i$$

Schema per risolvere i problemi di e.s.

1) Individuare dove sono le cariche (sorgenti)

2) Calcolare il campo el. usando pr. sovrapp. : $\underline{E}$

3) $\underline{F}$ in un certo punto P: su q_P $\quad \underline{F} = q_P \underline{E}$

Se $q_P > 0$: $\underline{F} \parallel \underline{E}$
Se $q_P < 0$: $\underline{F}$ anti $\parallel \underline{E}$

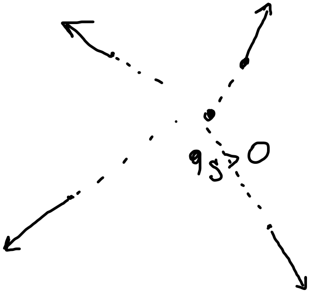
Rappresentazione grafica del campo el.

Linea di forza

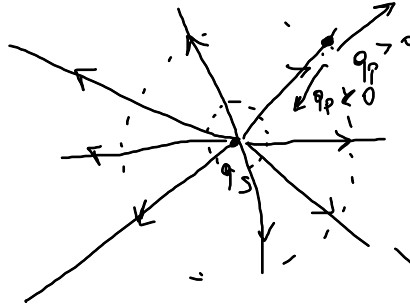
a) $\underline{E}$ é tangente alla linea di forza in un pto

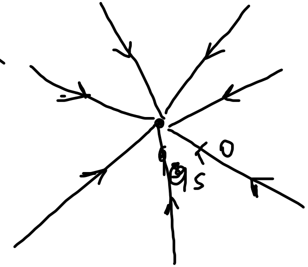
b) Orientamento della " " " " " " é come il $\underline{E}$

c) # linee di forza per unità di sup. é $\propto |\underline{E}|$ in quella zona



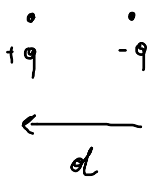
$$\underline{E} = k_e \frac{q_s}{r^2}\,\hat{\underline{r}}$$

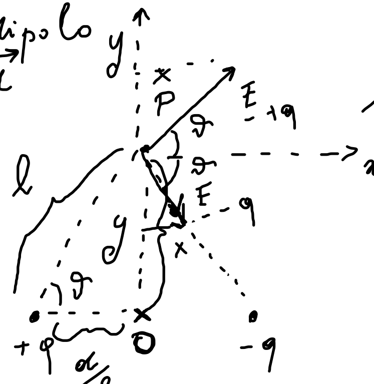




Dipolo

mom. di dipolo $\vec{p} = q\,\vec{d}$





$$\underline{E} = \underline{E}_{+q} + \underline{E}_{-q}$$

$$|\underline{E}_{+q}| = |\underline{E}_{-q}|$$

$$|E_{+q}| = k_e \frac{q}{l^2}$$

$$E_{y+q} = -E_{y-q} \Rightarrow E_y = 0 \qquad E_{x,q} = E_{x-q}$$

$$E_x = 2E_{x+q} = 2\cdot E_{+q}\cos\vartheta$$

$$\cos\vartheta = \frac{d/2}{l}$$

$$l = \sqrt{\frac{d^2}{4}+y^2}$$

$$E_x = \cancel{2}\cdot \frac{k_e\, q}{\underbrace{\left(\frac{d^2}{4}+y^2\right)}_{l^2}} \cdot \underbrace{\frac{d/\cancel{2}}{\underbrace{\left(\frac{d^2}{4}+y^2\right)^{\frac{1}{2}}}_{l}}}_{\cos\vartheta} = \frac{k_e\, q\, d}{\left(\frac{d^2}{4}+y^2\right)^{3/2}}$$

$$\underline{\vec{E}}$$

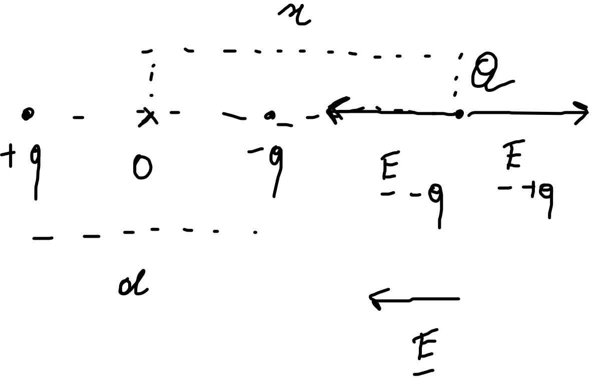
Generalmente $d \ll y$

$$\frac{d^2}{4} \ll y^2$$

$$E_x \simeq k_e\, q \frac{d}{y^3}$$

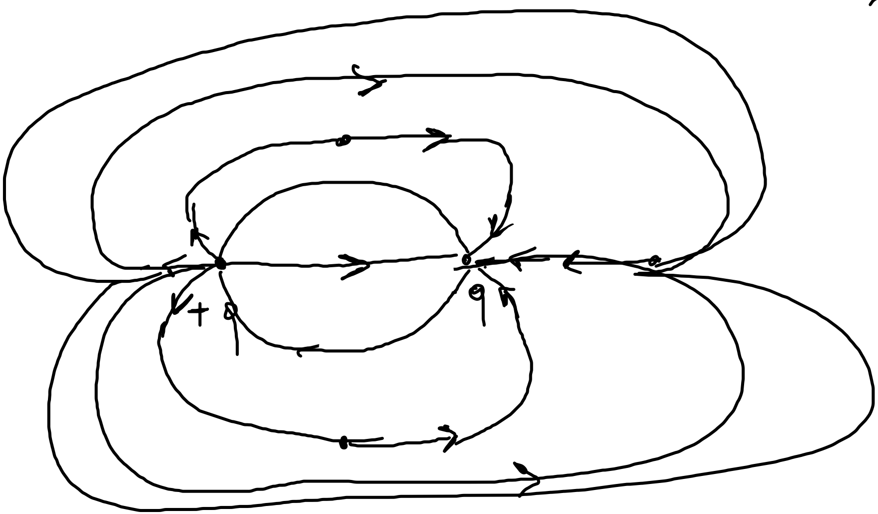
$$E \propto \frac{1}{y^2}$$

c. ptiforme



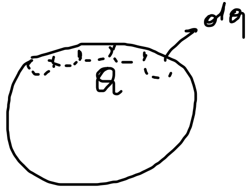
$$\underline{E}(Q) = \underline{E}_{+q}(Q) + \underline{E}_{-q}(Q)$$

$$\underline{E}_{+q} = k_e \frac{q}{\left(x + \frac{d}{2}\right)^2} \qquad \underline{E}_{-q} = -\frac{k_e q}{\left(x - \frac{d}{2}\right)^2}$$



Q in un certo volume $\mathcal{V}$

$\frac{dq}{Q} \to 0$



$\cdot P$

$$\underline{E}(P) = \sum_{\text{tutte le } dq} \underline{E}(dq) = \sum_{\text{tutte le } dq} \frac{k_e\, dq}{r^2}\,\hat{\underline{r}}$$

$$= \int_{\text{volume}} \frac{k_e\, dq}{r^2}\,\hat{\underline{r}} = \int \frac{k_e\, \rho(\underline{r})\,\hat{\underline{r}}\, d\mathcal{V}}{r^2}$$

$dq = d\mathcal{V} \cdot \rho(\underline{r})$

Def. densità di carica: $\rho(\underline{r}) = \frac{dq}{d\mathcal{V}}$