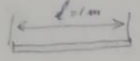
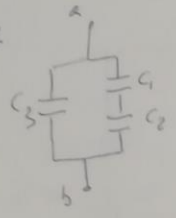
Correzione Prova parziale 4/11/2020.

#1. $i = \frac{4.1}{14\,\Omega} = 0{,}29\,A$ $\quad \Delta V = 4{,}1\ V$, $R = 14\,\Omega$



E uniforme nel filo: $E = \frac{\Delta V}{d} = \frac{4.1}{1} = 4.1\ V/m.$

#2



$C_1 = 4\,\mu F$, $C_2 = 6\,\mu F$, $C_3 = 5\,\mu F$, $V_{ab} = 65\,V$

$C_{tot} = C_3 + \frac{C_1 C_2}{C_1 + C_2} = 5\,\mu F + \frac{4\times 6}{10}\,\mu F = 7{,}4\,\mu F$

$\Delta V(C_3) = 65\ V \Rightarrow Q_3 = 65 \times 5\,\mu F = 325\,\mu C$

C_1, C_2 in serie $\Rightarrow C_{eq} = 2{,}4\,\mu F$

su C_1, C_2 $\quad Q_{1,2} = 2{,}4\,\mu F \times 65 = 156\,\mu C$

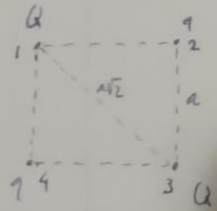
ma $Q_1 = Q_2 = Q_{1,2}$ perché:

$\Delta V(C_1) = \frac{Q_1}{C_1} = \frac{156}{4}\frac{\mu C}{\mu F} = 39\ V$

$\Delta V(C_2) = \frac{Q_2}{C_2} = \frac{156}{6}\ V = 26\ V$

$E_{TOT} = \frac{1}{2} C_{TOT} V^2 = \frac{1}{2} 7{,}4\times 10^{-6} (65)^2 = \frac{7{,}4\times 4{,}22}{2} \times 10^{-3} = 15{,}614\ mJ.$

#3



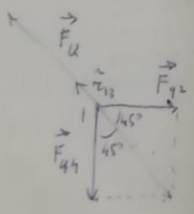
osservo che se le cariche avessero stesso segno la risultante su una carica non può essere nulla.

consideriamo carica "1"

- forza da carica 3: $\vec{F}_Q = \frac{1}{4\pi\varepsilon_0}\frac{Q^2}{(a\sqrt{2})^2}\hat{r}_{13} = \frac{1}{4\pi\varepsilon_0}\frac{Q^2}{2a^2}\hat{r}_{13}$

- forze da carica q in 2,4: $\vec{F}_{q4} = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{a^2}$, $\vec{F}_{q2} = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{a^2}$

$|\vec{F}_{q2}| = |\vec{F}_{q4}| \Rightarrow \vec{F}_q^{13} = \sqrt{2}\,|\vec{F}_{q2}|$



per avere risultante nulla

$\frac{1}{4\pi\varepsilon_0}\frac{qQ}{q^2}\sqrt{2} = \frac{1}{4\pi\varepsilon_0}\frac{Q^2}{2a^2}$

$|q| = \frac{1}{2\sqrt{2}}|Q| \Rightarrow \boxed{q = -\frac{Q}{2\sqrt{2}}}$

#4

$r < a$: $E = 0$

$r > b$: $E = 0$

$\lambda = \frac{Q}{\ell}$

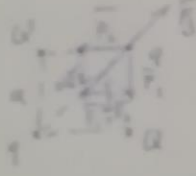
$a < r < b$: $E 2\pi r \ell = \frac{\lambda \ell}{\varepsilon_0} \Rightarrow E = \frac{\lambda}{2\pi\varepsilon_0 r}$

$$V(b) - V(a) = \int_b^a E\,dr = \frac{\lambda}{2\pi\varepsilon_0} \int_b^a \frac{1}{r}\,dr = \frac{\lambda}{2\pi\varepsilon_0} \ln\frac{a}{b}$$

$$C = \frac{Q}{\Delta V} = \frac{\lambda \ell}{\frac{\lambda}{2\pi\varepsilon_0} \ln\frac{a}{b}} = 2\pi\varepsilon_0 \ln^{-1}\frac{a}{b} = -2\pi\varepsilon_0 \ln\frac{a}{b} = 2\pi\varepsilon_0 (\ln b - \ln a).$$

#3 - seconda domanda:

perché $q = -\frac{Q}{\sqrt{2}}$, $|\vec{F}_1| = |\vec{F}_2| = \frac{1}{4\pi\varepsilon_0} \frac{qQ}{a^2}$



$$|\vec{F}_3| = \frac{1}{4\pi\varepsilon_0} \frac{q^2}{2a^2}$$

Il modulo della risultante

$|\vec{F}_1 + \vec{F}_2|$ vale $\frac{q^2}{\pi\varepsilon_0 a^2}$

perciò la risultante sulla carica q vale:

$$\frac{1}{4\pi\varepsilon_0} \frac{q^2}{2a^2} - \frac{q^2}{\pi\varepsilon_0 a^2} = \frac{q^2 - 8q^2}{8\pi\varepsilon_0 a^2} = \frac{-7q^2}{8\pi\varepsilon_0 a^2}$$

6