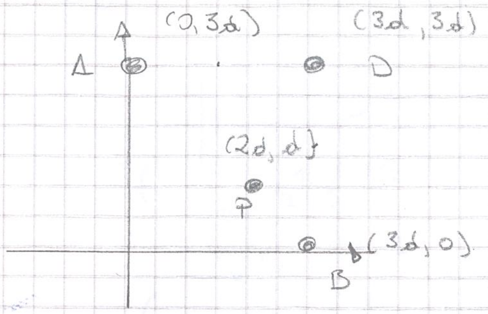
Es #2



$Q_A = 4q_0$

$Q_D = -q_0$

a) Determino i vettori $\vec{r}_{AP}$ e $\vec{r}_{BP}$

$\vec{r}_{AP} = 2d\vec{i} - 2d\vec{j}$ $\qquad |\vec{r}_{AP}| = 2d\sqrt{2}$

$\vec{r}_{BP} = -d\vec{i} + d\vec{j}$ $\qquad |\vec{r}_{BP}| = d\sqrt{2}$

Campo elettrico prodotto da Q_A in P: $\vec{E}_{QA}(P) = K_e \frac{Q_A}{8d^2}\frac{1}{\sqrt{2}}(\vec{i}-\vec{j})$

Campo elettrico prodotto da Q_B in P $\vec{E}_{QB}(P) = K_e \frac{Q_B}{2d^2}\frac{1}{\sqrt{2}}(-\vec{i}+\vec{j})$

$\vec{E}(P) = \vec{E}_{QA}(P) + \vec{E}_{QB}(P) = 0 \Rightarrow \frac{Q_A}{8d^2} = \frac{Q_B}{2d^2} \rightarrow Q_B = \frac{1}{4}Q_A = q_0$

b) Determino i vettori $\vec{r}_{AD}$ e $\vec{r}_{BD}$

$\vec{r}_{AD} = 3d\vec{i}$ $\qquad |\vec{r}_{AD}| = 3d$

$\vec{r}_{BD} = 3d\vec{j}$ $\qquad |\vec{r}_{BD}| = 3d$

Campo elettrico prodotto da Q_A in D $\vec{E}_{QA}(D) = K_e \frac{Q_A}{9d^2}\vec{i}$

Campo elettrico prodotto da Q_B in D $\vec{E}_{QB}(D) = K_e \frac{Q_B}{9d^2}\vec{j}$

$\vec{E}(D) = \vec{E}_{QA}(D) + \vec{E}_{QB}(D) = K_e \frac{4q_0}{9d^2}\vec{i} + K_e \frac{q_0}{9d^2}\vec{j}$

$\vec{F} = Q_D \vec{E}(D) = -K_e \frac{q_0^2}{9d^2}(4\vec{i}+\vec{j})$

c) $L = Q_D(V(D) - V(P))$

~~Sovrapp~~ Additività dei potenziali

$V(B) = K_e \frac{Q_A}{3d} + K_e \frac{Q_B}{3d}$

$V(P) = K_e \frac{Q_A}{2d\sqrt{2}} + K_e \frac{Q_B}{d\sqrt{2}}$

$\Rightarrow L = Q_D K_e \left\{ (Q_A+Q_B)\frac{1}{3d} - (Q_A+2Q_B)\frac{1}{2d\sqrt{2}} \right\}$

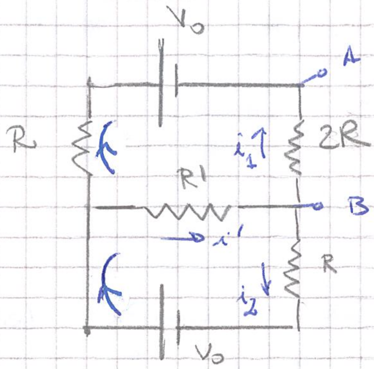
$= -K_e q_0^2 \frac{1}{d} \underbrace{\left[\frac{5}{3} - \frac{3\sqrt{2}}{2}\right]}_{\simeq -0.45}$ $\qquad$ NB: $L > 0$

d) Applicando conservazione energia meccanica

$\frac{1}{2}m_D v_f^2 - \underbrace{\frac{1}{2}m_D v_i^2}_{v_i = 0} = Q_D[V(B) - V(P)] = \frac{K_e q_0^2}{d}\left[\frac{3\sqrt{2}}{2} - \frac{5}{3}\right] \rightarrow v_f^2 = \frac{2K_e q_0^2}{m_D d}\left[\frac{3\sqrt{2}}{2} - \frac{5}{3}\right]$

Es #3

a) $X = C$ → in condizioni stazionarie si comporta come circuito aperto



L. di Kirchhoff nodi $\quad i' = i_1 + i_2$

Maglia sup. $\quad -V_0 + 3R i_1 + R' i' = 0$

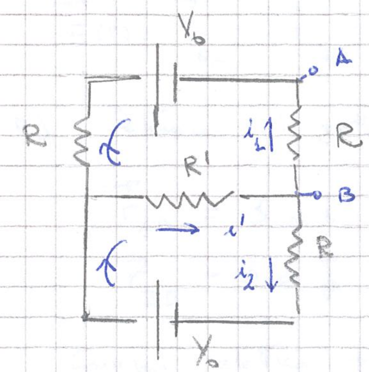
Maglia inf. $\quad V_0 - R i_2 - R' i' = 0$

$$\Rightarrow 3R i_1 - R i_2 = 0 \Rightarrow i_2 = 3 i_1$$
$$i' = 4 i_1$$

$$-V_0 + 3R i_1 + (2R)(4 i_1) = 0 \qquad i_1 = \frac{V_0}{11R} \qquad i' = \frac{4V_0}{11R} = 21.8 \text{ mA}$$

$$V_A + 2R i_1 = V_B \rightarrow V_A - V_B = -\frac{2V_0}{11} = -10.9 \text{ V}$$

b) $X = L$ → in condizioni stazionarie si comporta come corto circuito



L. di Kirchhoff nodi $\quad i' = i_1 + i_2$

Maglia sup. $\quad -V_0 + i_1 2R + i' 2R = 0$

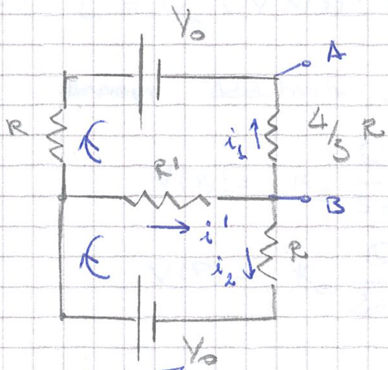
Maglia inf. $\quad +V_0 - i_2 R - i' 2R = 0$

$$\Rightarrow i_1 2R - i_2 R = 0 \Rightarrow i_2 = 2 i_1$$
$$i' = 3 i_1$$

$$-V_0 + 2R i_1 + (2R)(3 i_1) = 0 \qquad i_1 = \frac{V_0}{8R} \qquad i' = \frac{3V_0}{8R} = 22.5 \text{ mA}$$

$$V_A + R i_1 = V_B \rightarrow V_A - V_B = -\frac{V_0}{8} = -7.5 \text{ V}$$

c) $X = R$



L. di Kirchhoff nodi $\quad i' = i_1 + i_2$

Maglia sup. $\quad -V_0 + \frac{7}{3} R i_1 + R' i' = 0$

Maglia inf. $\quad V_0 - R i_2 - R' i' = 0$

$$\Rightarrow \frac{7}{3} R i_1 - R i_2 = 0 \qquad i_2 = \frac{7}{3} i_1$$
$$i' = \frac{10}{3} i_1$$

$$-V_0 + \frac{7}{3} R i_1 + (2R)\left(\frac{10}{3} i_1\right) = 0 \rightarrow i_1 = \frac{V_0}{9R} \qquad i' = \frac{10}{27}\frac{V_0}{R} = 22.2 \text{ mA}$$

$$V_A + \frac{4}{3} R i_1 = V_B \rightarrow V_A - V_B = -\frac{4}{27} V_0 = -8.9 \text{ V}$$