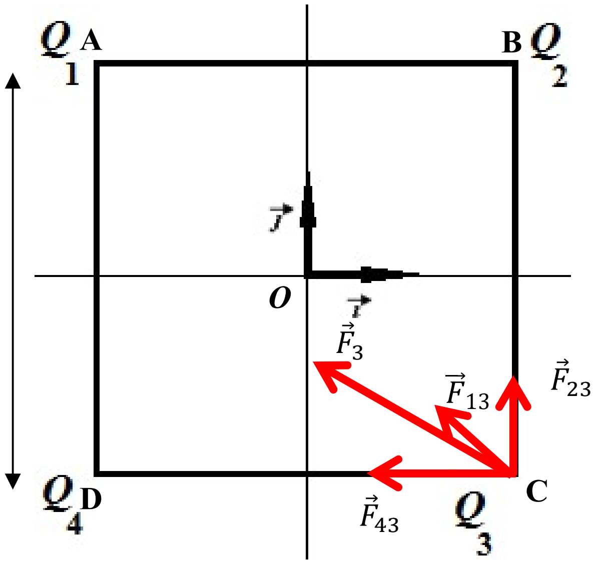
# *Corrigé du Contrôle de Rattrapage de Physique II*(10/06/2023)

## Exercice 01 (06pts)




1°/ $\vec{F}_{13} = K\frac{Q_1Q_3}{\|\overrightarrow{AC}\|^2}\vec{u}_{13}$, $\vec{u}_{13} = \frac{\overrightarrow{AC}}{\|\overrightarrow{AC}\|}$, $A\left(\frac{-a}{2},\frac{a}{2}\right), B\left(\frac{a}{2},\frac{a}{2}\right), C\left(\frac{a}{2},\frac{-a}{2}\right)$

$, D\left(\frac{-a}{2},\frac{-a}{2}\right), \overrightarrow{AC} = a\vec{\imath} - a\vec{\jmath}$ et $\|\overrightarrow{AC}\| = \sqrt{2}a$

$\vec{F}_{13} = K\frac{q^2}{\sqrt{2}a^2}(-\vec{\imath}+\vec{\jmath}), \vec{F}_{23} = K\frac{2q^2}{a^2}\vec{\jmath}$ et $\vec{F}_{43} = -K\frac{4q^2}{a^2}\vec{\imath}.$

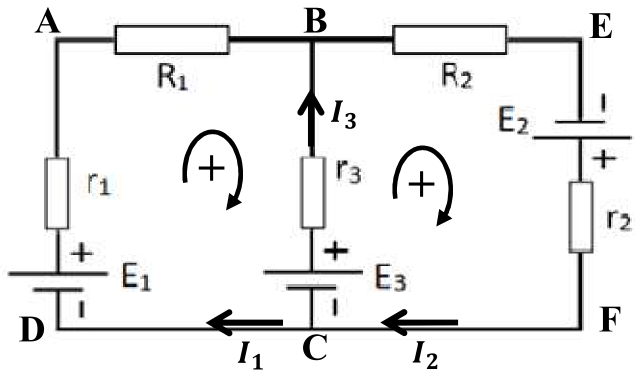
2°/ $\vec{F}_3 = \vec{F}_{13} + \vec{F}_{23} + \vec{F}_{43}$

$\vec{F}_3 = K\frac{q^2}{\sqrt{2}a^2}(-\vec{\imath}+\vec{\jmath}) + K\frac{2q^2}{a^2}\vec{\jmath} - K\frac{4q^2}{a^2}\vec{\imath}.$

$\vec{F}_3 = -Kq^2\left(\frac{1+4\sqrt{2}}{\sqrt{2}a^2}\vec{\imath} - \frac{1+2\sqrt{2}}{\sqrt{2}a^2}\vec{\jmath}\right).$

3°/ $\vec{F} = q\vec{E} \rightarrow \vec{E} = \frac{\vec{F}}{q} \leftrightarrow \vec{E} = -Kq\left(\frac{1+4\sqrt{2}}{\sqrt{2}a^2}\vec{\imath} - \frac{1+2\sqrt{2}}{\sqrt{2}a^2}\vec{\jmath}\right)$

## Exercice 04 (05pts)




1°/ Ecrivons les lois de Kirchhoff :

✓ ***Première loi***:loi des noeuds

En un nœud d'un circuit, la somme algébrique des courants est nulle.

$\sum_{k=1}^{n} I_k = 0 \leftrightarrow \sum I_{entrants} = \sum I_{sortants}$

$I_1 + I_3 = I_2$ (01)

✓ ***Deuxième loi:*** loi des mailles

$$\sum_{k=1}^{n} E_k - \sum_{k=1}^{n} R_k I_k = 0$$

*Maille (**ABCDA**):* $E_1 - E_3 - r_1I_1 - R_1I_1 + r_3I_3 = 0$ (02)

*Maille (**BEFCB**):* $E_2 + E_3 - r_3I_3 - R_2I_2 - r_2I_2 = 0$ (03)

les intensités des courants $I_1$, $I_2$ *et* $I_3$

$$\begin{cases} I_1 + I_3 = I_2 & (01) \\ 11 + I_3 - 6I_1 = 0 & (02) \\ 10 - I_3 - 5I_2 = 0 & (03) \end{cases}$$

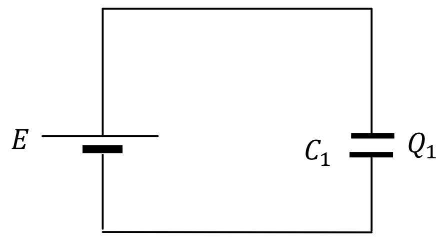
L'équation (1) donne $I_1 + I_3 = I_2$ , que l'on substitue dans les équations (3)

Les équations (3) deviennent**:** $10 - 6I_3 - 5I_1 = 0$ (04).

Les équations (3) et (4) forment un système de deux équations à deux inconnues. Ce système a pour solutions: $I_1 = \frac{76}{41}A = 1{,}85A$, $I_3 = \frac{5}{41}A = 0{,}12A$ et $I_2 = \frac{81}{41}A = 1{,}97A$.

**Exercice 03 (05pts):**

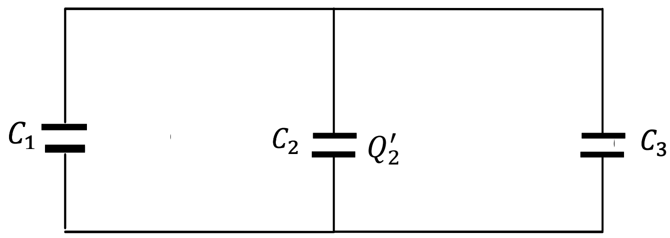
1°/ ***1ere cas:*** ***S₁*** *est fermé et* ***S₂*** *est ouvert.*




$V_1 = E = \frac{Q_1}{C_1}, V_1 = E = 10\ V \rightarrow Q_1 = C_1V_1 = 20\mu C.$

$Q_2 = C_2V_2 = 0\ \ et\ Q_3 = C_3V_3 = 0.$

2°/ ***2éme cas:*** ***S₂*** *est fermé et* ***S₁*** *est ouvert.*




$V_1' = V_2' = V_3'$ (01)

$\frac{Q_1'}{C_1} = \frac{Q_2'}{C_2} = \frac{Q_3'}{C_3}$ (02)

$Q_1 = Q_1' + Q_2' + Q_3' = 20\mu C$ (03)

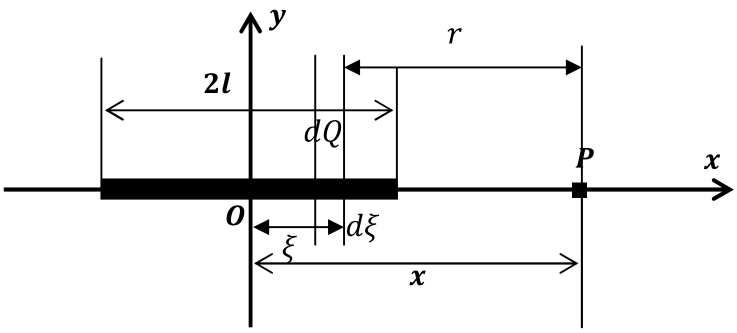
$$(02) \rightarrow \begin{cases} Q_2' = \dfrac{C_2}{C_1}Q_1' & (04) \\ Q_3' = \dfrac{C_3}{C_1}Q_1' & (05) \end{cases}$$

(04) et (05) dans (03)

$$Q_1 = Q_1' + \frac{C_2}{C_1}Q_1' + \frac{C_3}{C_1}Q_1' = Q_1'\left(1 + \frac{C_2}{C_1} + \frac{C_3}{C_1}\right) \leftrightarrow\ Q_1 = Q_1'\left(1 + \frac{3}{2} + \frac{5}{2}\right) \leftrightarrow\ Q_1 = Q_1'5 \leftrightarrow\ Q_1' = \frac{20}{5} = 4\mu C$$

$(4) \rightarrow Q_2' = \frac{3}{2}Q_1' = 6\mu C\ et\ (5) \rightarrow Q_3' = \frac{5}{2}Q_1' = 10\mu C\ \ , V_1' = \frac{Q_1'}{C_1} = \frac{4}{2} = 2V\ etV_1' = V_2' = V_3' = 2V$

**Exercice 02 (04pts):**




$1°/dV = K\frac{dQ}{r}$ or $r = x - \xi$ et $dQ = \lambda d\xi$

$dV = K\frac{\lambda d\xi}{x-\xi} \rightarrow V = \int dV = \int_{-l}^{l}\frac{\lambda}{4\pi\varepsilon_0}\frac{d\xi}{x-\xi}$

$V = -\int_{-l}^{l}\frac{\lambda}{4\pi\varepsilon_0}\frac{d\xi}{\xi-x} \rightarrow V(x) = -\frac{\lambda}{4\pi\varepsilon_0}\ln(\xi - x)\Big|_{-l}^{\ l}$

$\rightarrow V(x) = -\frac{\lambda}{4\pi\varepsilon_0}\ln\left(\frac{\mathrm{x-l}}{\mathrm{x+l}}\right)$

$2°/\ \vec{E} = -\overrightarrow{grqd}V \rightarrow \vec{E} = -\frac{dV}{dx}\vec{\imath}$

$$\vec{E} = -\frac{d\left[-\frac{\lambda}{4\pi\varepsilon_0}\ln\left(\frac{\mathrm{x-l}}{\mathrm{x+l}}\right)\right]}{dx}\vec{\imath} = -\frac{2\lambda l}{4\pi\varepsilon_0(x^2 - l^2)}\vec{\imath} = -\frac{Q}{4\pi\varepsilon_0(x^2 - l^2)}\vec{\imath}$$