UNIVERSITE BLIDA 1
Département : T.C S.T
Module : Physique 2

Année 2022/2023

SERIE D'EXERCICE SUR LES CIRCUITS ELECTRIQUES

EX:-1- Pour le circuit de la **figure1** ,montrer que $U_{CB}= U_{AB}\frac{R_1}{R_1+R_2}$ (diviseur de tension).

EX-2- Pour le circuit de la **figure 2**,montrer que $I_1=I\frac{R_2}{R_1+R_2}$ et $I_2=I\frac{R_1}{R_1+R_2}$ (diviseur de courant).

EX-3-Pour le circuit de la **figure 3** et en utilisant les lois de KIRCHOFF calculer les courants I_1 ,I_2 et I_3

EX-4- On considère le circuit de la **figure 4** ,on donne :E_1=8 v;E_2=4v,r_1=0,5Ω,r_2=0,4Ω,R_1=R_2=30Ω, R_3=50 Ω ,R_4=20 Ω.

1)-Calculer l'intensité des courants dans chacune des branches.

2)-On place en série avec R_3 et R_4 une résistance R.Pour quelle valeur de R le courant qui circule dans R_2 le triple que celui qui circule dans R_4.

EX-5-Pour le circuit de la **figure5**, calculer:

1)-La valeur qu'il faut donner à R_0 pour que le rendement électrique de E_g soit égal à η= 0,8.

2)-La valeur qu'il faut donner à R_0 pour que la puissance dissipée dans R_0 soit maximale et tracer $P(R_0)$.

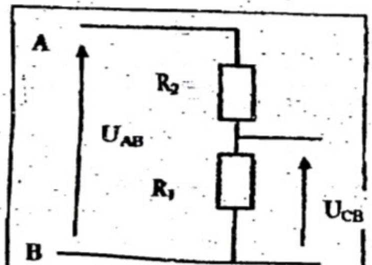


FIGURE-1-

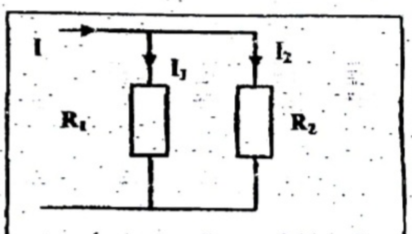


FIGURE-2-

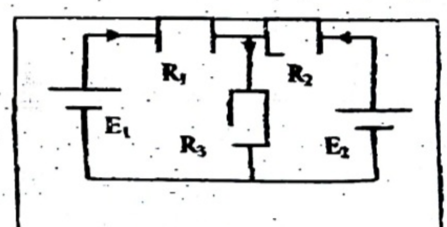


FIGURE-3-

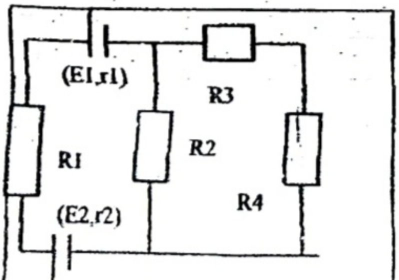


FIGURE-4-

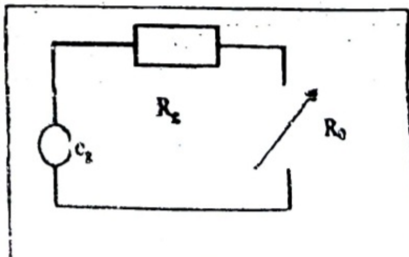
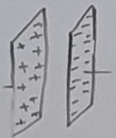
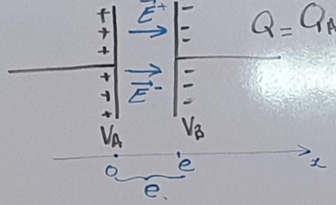


FIGURE-5-

Exo 3 : $S = 100\ cm^2$, $e = 1\ mm$

1) C ? $C = \dfrac{Q}{V_A - V_B} = ?$





$Q = Q_A = |Q_B|$

- $Q = \sigma . S$
- $V_A - V_B = ?$

$E = ?$ entre les 2 plaques. $\boxed{\vec{E} = \vec{E}^+ + \vec{E}^- = \dfrac{\sigma}{2\varepsilon_0}\vec{i} + \dfrac{\sigma}{2\varepsilon_0}\vec{i} = \dfrac{\sigma}{\varepsilon_0}\vec{i}}$

$$\int_{V_A}^{V_B} dV = -\int_0^e \vec{E}.\vec{dl} = -\int_0^e E.dx = -\int_0^e \frac{\sigma}{\varepsilon_0} dx = -\frac{\sigma}{\varepsilon_0}\int_0^e dx$$

$$\Big[V\Big]_{V_A}^{V_B} = -\frac{\sigma}{\varepsilon_0}\Big[x\Big]_0^e \rightarrow V_B - V_A = -\frac{\sigma}{\varepsilon_0}.e$$

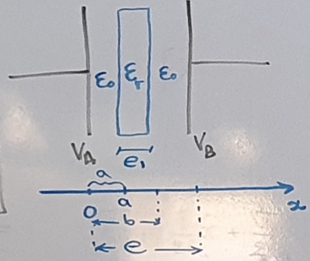
$$\rightarrow \boxed{V_A - V_B = \frac{\sigma}{\varepsilon_0}.e}$$

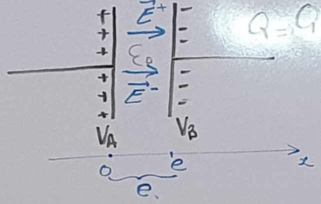
donc : $\boxed{C = \dfrac{Q}{V_A - V_B} = \dfrac{\sigma . S}{\sigma/\varepsilon_0 . e} = \dfrac{S.\varepsilon_0}{e}}$

$$\begin{cases} S = 100\ cm^2 = \dots\ m^2 \\ e = 1\ mm = \dots\ m \\ \varepsilon_0 = 8.82.10^{-12} \end{cases}$$

Exo 3: $S = 100\ cm^2$, $e = 1\ mm$

2) $C = \dfrac{Q}{V_A - V_B}$?





$Q = Q_A = |Q_B|$

$\varepsilon = \varepsilon_0$ air

$\varepsilon = \varepsilon_r \times \varepsilon_0$ ébonite $\varepsilon_r = 3$

$$\boxed{C = \frac{S.\varepsilon_0}{e}}$$

$$\int_{V_A}^{V_B} dV = -\int E\, dx$$

$$V_B - V_A = -\left[\int_0^a \frac{\sigma}{\varepsilon_0} dx + \int_a^b \frac{\sigma}{\varepsilon_0 \underbrace{\varepsilon_r}_{=3}} dx + \int_b^e \frac{\sigma}{\varepsilon_0} dx\right]$$

$$\boxed{= \frac{\sigma}{\varepsilon_0} \vec{i}}$$

$$= -\frac{\sigma}{\varepsilon_0}\left[\int_0^a dx + \frac{1}{3}\int_a^b dx + \int_b^e dx\right]$$

$b - a = e_1$

$$= -\frac{\sigma}{\varepsilon_0}\left[[x]_0^a + \frac{1}{3}[x]_a^b + [x]_b^e\right]$$

$\frac{1}{3} - 1 = \frac{1}{3} - \frac{3}{3}$

$$= -\sigma/\varepsilon_0 \left[a + \frac{1}{3}\underbrace{(b-a)}_{e_1} + (e-b)\right] \quad -2/3\, e_1$$

$$V_B - V_A = -\frac{\sigma}{\varepsilon_0}\left[\underbrace{(a-b)}_{-e_1} + \frac{e_1}{3} + e\right] = -\frac{\sigma}{\varepsilon_0}\left[\underbrace{-e_1 + \frac{e_1}{3}}_{} + e\right] = -\frac{\sigma}{\varepsilon_0}\left[e - \frac{2}{3}e_1\right]$$

$$\Rightarrow V_A - V_B = \frac{\sigma}{\varepsilon_0}\left[e - \frac{2}{3}e_1\right]$$

$$\Rightarrow \boxed{C = \frac{Q}{V_A - V_B} = \frac{\sigma.S}{\frac{\sigma}{\varepsilon_0}(e - \frac{2}{3}e_1)} = \frac{S.\varepsilon_0}{e - \frac{2}{3}e_1}}$$

Exo 3 : $S = 100\ cm^2$, $e = 1\ mm$

2) $C = \dfrac{Q}{V_A - V_B}$?

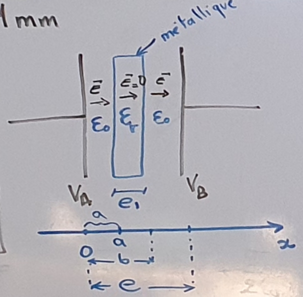
$\int_{V_A}^{V_B} dV = -\int E\, dx$

$V_B - V_A = -\left[\int_0^a \frac{\sigma}{\varepsilon_0} dx + 0 + \int_b^e \frac{\sigma}{\varepsilon_0} dx\right]$

$V_B - V_A = -\frac{\sigma}{\varepsilon_0}\left[\int_0^a dx + 0 + \int_b^e dx\right]$

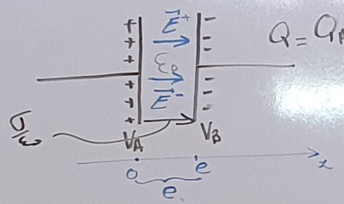
$= -\frac{\sigma}{\varepsilon_0}\left[(a-0) + 0 + (e-b)\right]$

$V_B - V_A = -\frac{\sigma}{\varepsilon_0}\left[e + \overbrace{(a-b)}^{-e_1}\right] = -\frac{\sigma}{\varepsilon_0}\left[e - e_1\right] \rightarrow \boxed{V_A - V_B = \frac{\sigma}{\varepsilon_0}(e - e_1)}$



$b - a = e_1$

$= \frac{\sigma}{\varepsilon_0}\vec{i}$



$Q = Q_A = |Q_B|$

$\varepsilon = \varepsilon_0$ air

$\varepsilon = \varepsilon_r \times \varepsilon_0$ ébonite $\varepsilon_r = 3$

$\boxed{C = \dfrac{S.\varepsilon_0}{e}}$

$\Rightarrow \boxed{C = \dfrac{Q}{V_A - V_B} = \dfrac{\sigma.S}{\frac{\sigma}{\varepsilon_0}(e - e_1)} = \dfrac{S.\varepsilon_0}{e - e_1}}$ ↗

Exo 3: $S = 100\ cm^2$, $e = 1\ mm$ $(Q = \sigma . S)$

3) $V_A - V_B = 3000\,V$

$$\vec{F} = Q.\vec{E} \rightarrow F = Q\,E^{=\sigma/\varepsilon_0} = \frac{Q.\sigma^{=Q/S}}{\varepsilon_0} = \frac{Q^2}{S\varepsilon_0} \qquad \sigma/\varepsilon_0$$

$$C = \frac{Q}{V_A - V_B} = \frac{S\varepsilon_0}{e} \rightarrow Q = \frac{S\,\varepsilon_0 (V_A - V_B)}{e}$$

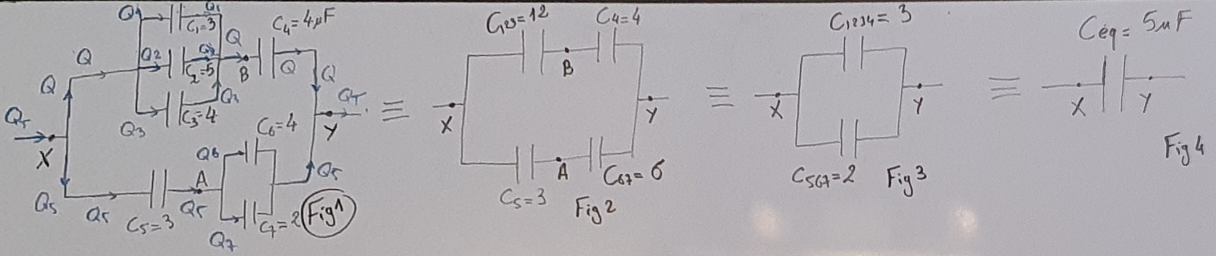
d'où : $$F = \frac{Q^2}{S\varepsilon_0} = \frac{S^2 . \varepsilon_0^2 (V_A - V_B)^2}{S . \varepsilon_0 . e^2} = \frac{S . \varepsilon_0 . (V_A - V_B)^2}{e^2} = \dots N$$

Exo 4.

Si $C_1 // C_2 \Rightarrow \boxed{C_{eq} = C_1 + C_2}$

Si C_1 et C_2 en serie

$$\boxed{\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}}$$



1) $C_{eq} = ?$ $\quad C_1 // C_2 // C_3 \rightarrow C_{123} = C_1 + C_2 + C_3 = 3 + 5 + 4 = \boxed{12\,\mu F}$

$C_6 // C_7 \longrightarrow C_{67} = C_6 + C_7 = 4 + 2 = \boxed{6\,\mu F}$

Fig 2: C_{123} et C_4 en serie $\Rightarrow \dfrac{1}{C_{1234}} = \dfrac{1}{C_{123}} + \dfrac{1}{C_4} = \dfrac{1}{12} + \dfrac{1}{4} = \dfrac{1}{12} + \dfrac{3}{12} = \dfrac{4}{12} = \dfrac{1}{3} \rightarrow \boxed{C_{1234} = 3\,\mu F}$

C_5 et C_{67} en serie $\Rightarrow \dfrac{1}{C_{567}} = \dfrac{1}{C_5} + \dfrac{1}{C_{67}} = \dfrac{1}{3} + \dfrac{1}{6} = \dfrac{2}{6} + \dfrac{1}{6} = \dfrac{3}{6} = \dfrac{1}{2} \rightarrow \boxed{C_{567} = 2\,\mu F}$

Fig 3: $C_{1234} // C_{567} \Rightarrow \boxed{C_{eq} = C_{1234} + C_{567} = 3 + 2 = 5\,\mu F}$

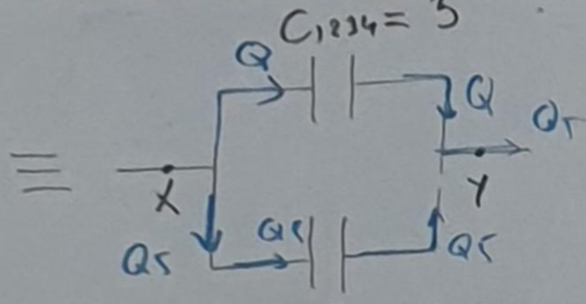


Fig 3

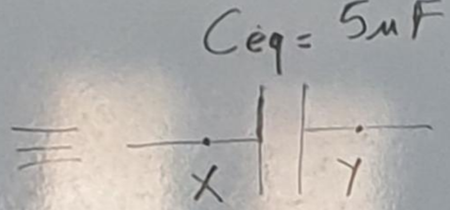
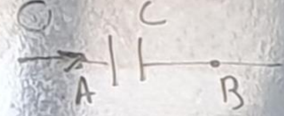


Fig 4

2·) Si $Q_2 = 120\mu C \rightarrow V_X - V_A = ?$

$$\boxed{V_X - V_B = \frac{\overset{?}{Q_1}}{C_1} = \frac{\overset{=120}{Q_2}}{\underset{=5\mu F}{C_2}} = \frac{\overset{?}{Q_3}}{C_3} = \frac{120.10^{-6}}{5.10^{-6}} = 24V}$$



$V_A - V_B = U = V = \frac{Q}{C}$

$\Rightarrow \frac{Q_1}{C_1} = 24 \Rightarrow Q_1 = 24 \times C_1 = 24 \times 3 = 72\mu C$

$\frac{Q_3}{C_3} = 24 \Rightarrow Q_3 = 24 \times C_3 = 24 \times 4 = 96\mu C$

$\Rightarrow$ la charge $\boxed{Q = Q_1 + Q_2 + Q_3 = 120 + 72 + 96 = 288\mu C}$ c'est la charge qui passe dans C_4

$$\boxed{V_B - V_Y = \frac{\overset{=Q}{Q_4}}{C_4} = \frac{288}{4} = 72V}$$

d'où : $\boxed{V_x - V_y = (V_x - V_B) + (V_B - V_y) = 24 + 72 = 96\,V}$

$V_x - V_A = ? = \frac{Q_5^?}{C_5}$ / Fig 3 : $V_x - V_y = \frac{Q_5}{C_{567}} \Rightarrow \boxed{Q_5 = (V_x - V_y) \times C_{567} = 96 \times 2 = 192\,\mu C}$

Finalement : $\boxed{V_x - V_A = \frac{Q_5}{C_5} = \frac{192}{3} = 64\,V}$