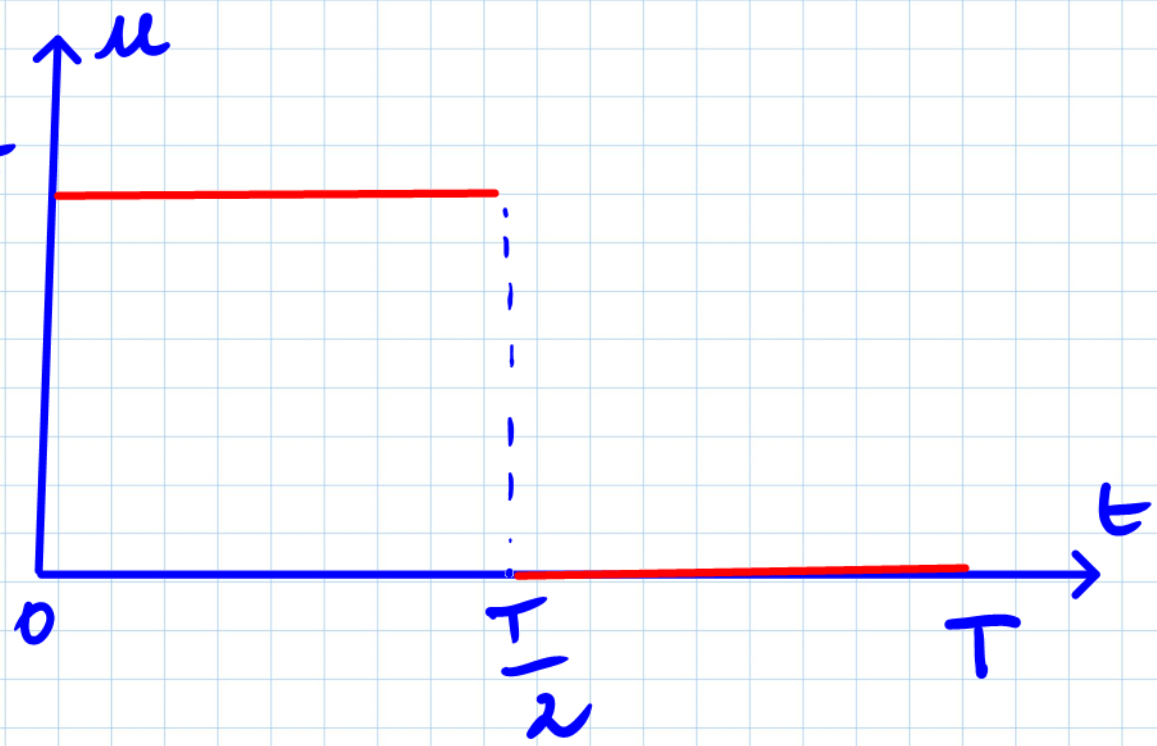
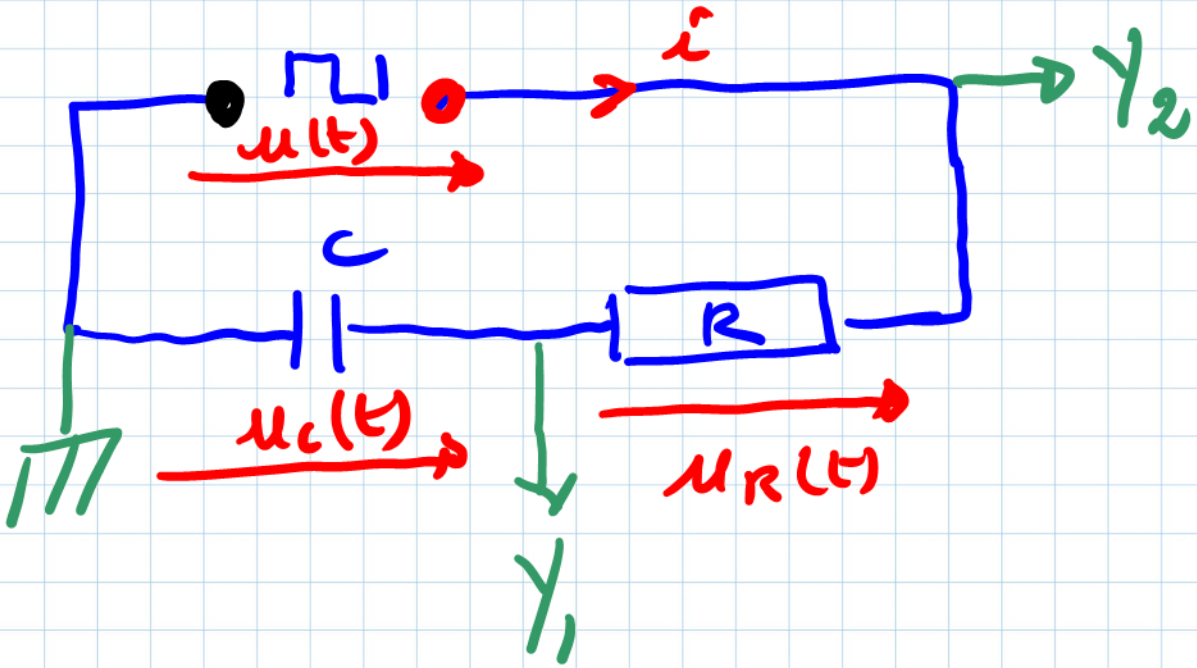
LE DIPOLE RC

Corrigé exercice 5 :

1.



2.



b. Loi des mailles :

$$u_C + u_R - u(t) = 0.$$

$t \in [0, T/2]$ $\quad u(t) = E$

$$u_C + Ri = E$$

or $i = \dfrac{dq}{dt}$ et $q = C \cdot u_C$ $\Rightarrow i = C \cdot \dfrac{du_C}{dt}$

$$\boxed{u_C + RC\frac{du_C}{dt} = E} \quad (1)$$

c) $u_C(t) = A(1 - e^{-\alpha t}) = A - Ae^{-\alpha t}$

c1. $\frac{du_C}{dt} = \frac{d}{dt}\left[A - Ae^{-\alpha t}\right]$

$= \alpha A e^{-\alpha t}$

① donne :

$A(1 - e^{-\alpha t}) + RC\alpha A e^{-\alpha t} = E$

$A - Ae^{-\alpha t} + RC\alpha A e^{-\alpha t} = E$

$Ae^{-\alpha t}\left[-1 + RC\alpha\right] + A = E$

Ceci est vrai $\forall t$ si :

$$\begin{cases} -1 + RC\alpha = 0 \\ A = E \end{cases} \Rightarrow \begin{matrix} \alpha = \frac{1}{RC} \\ A = E \end{matrix}$$

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$A = E = 10\ V$

$\alpha = \frac{1}{RC} = \frac{1}{10^3 \times 10^{-6}} = 10^3\ s^{-1}$

c₂. physiquement $A = E : U_{cmax}$

$\alpha = \frac{1}{RC} = \frac{1}{\tau}$: inverse de la constante de temps

d. $* \frac{T}{2} = 2RC = 2\tau$.

$u_c(t) = E\left(1 - e^{-t/\tau}\right)$

$t \in [0, T/2]$.

si $t = 0 \Rightarrow u_c = E\left(1 - e^{-\frac{0}{\tau}}\right) = 0$.

si $t = \frac{T}{2} \Rightarrow u_c = E\left(1 - e^{-\frac{T/2}{2\tau}}\right)$

$= E\left(1 - e^{-\frac{2\pi}{\pi}}\right)$

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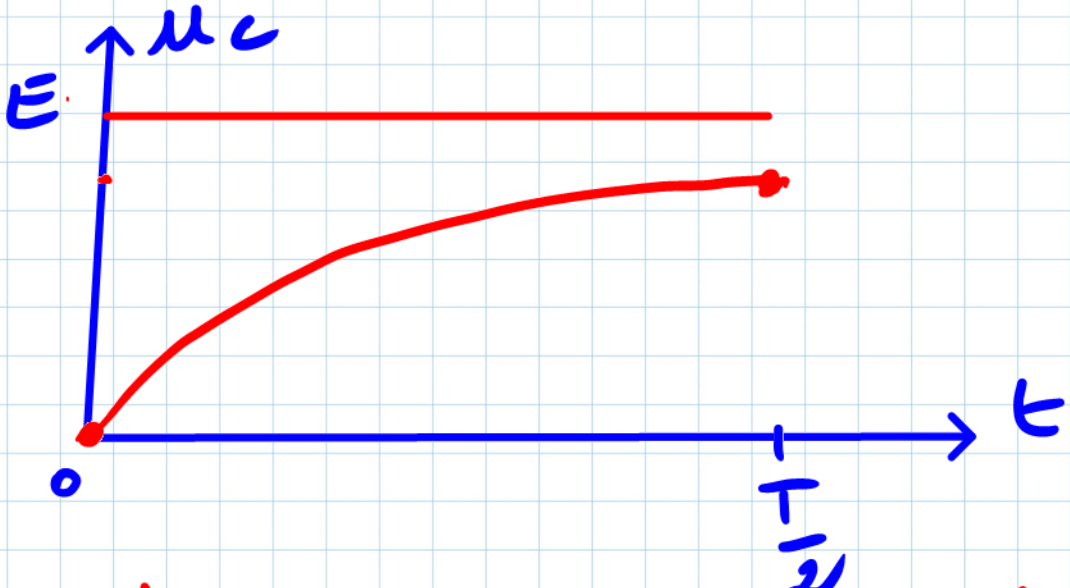
$u_c = E(1 - e^{-2}) = 0,86E = 8,6V$



le condensateur n'est pas totalement Chargé à $t = T/2$.

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* $\frac{T}{2} = 8RC$

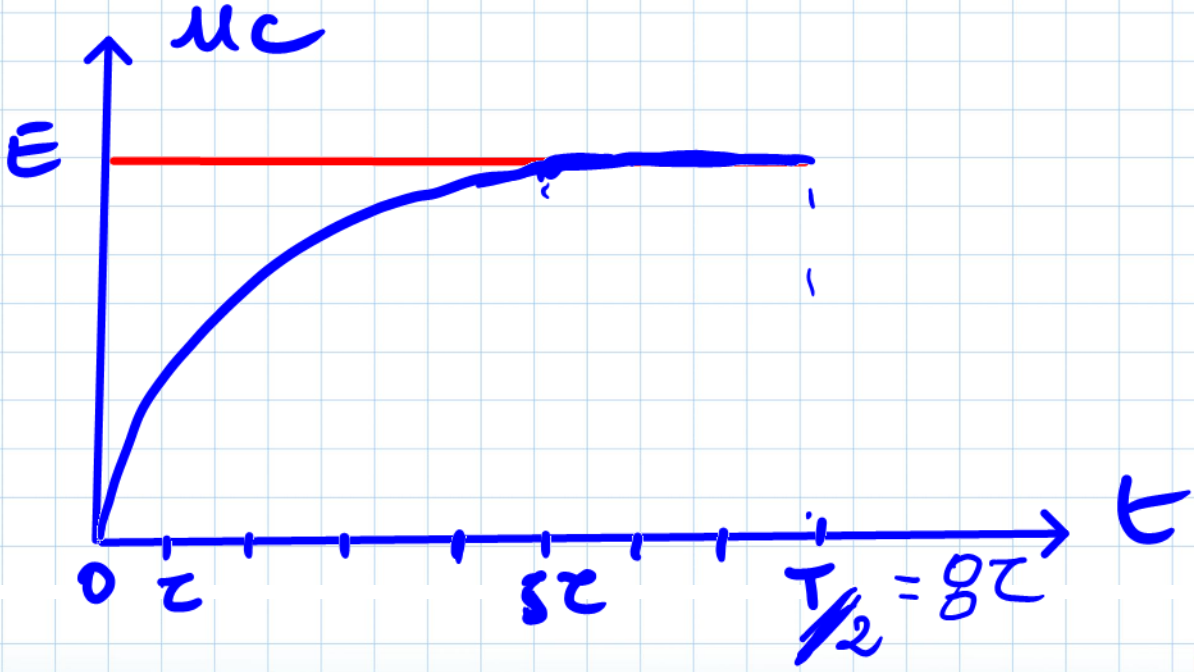
$u_c = E(1 - e^{-t/\tau})$

à $t = 0$ $\quad u_c = E(1 - e^{0}) = 0$

à $t = \frac{T}{2} = 8RC = 8\tau$.

$u_c = E(1 - e^{-\frac{8\tau}{\tau}})$

$= E(1 - e^{-8}) = E$



e) le condensateur est totalement chargé si $\frac{T}{2} \geq 5\tau$.

$T \geq 10\tau$; $N = \frac{1}{T}$

$N \leq \frac{1}{10\tau} = N_{max}$

$\alpha = \frac{1}{\tau} = 10^3 s^{-1} \Rightarrow \tau = 10^{-3} s$

$N_{max} = \frac{1}{10 \times 10^{-3}} = 100 Hz.$

$N \leq 100 Hz = N_{max}$

f/ $E_e = \frac{1}{2} C \cdot u_c^2$

lorsque le condensateur est totalement chargé $u_c = E$

$$E_e = \frac{1}{2} C \cdot E^2$$

$$E_e = \frac{1}{2} 10^{-6} \times 10^2 = 5 \cdot 10^{-5} \text{ J}$$

g) $q(t) = C \cdot u_c(t)$

$q_{max} = C \cdot E$

$q = 0,99\, q_{max}$

$C \cdot u_c = 0,99\, C \cdot E$

$C \cdot E(1 - e^{-t/\tau}) = 0,99\, C E$

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$1 - e^{-t/\tau} = 0,99 \Leftrightarrow e^{-t/\tau} = 0,01.$

Rq : $\ln e^{x} = x.$

$\Rightarrow \ln e^{-t/\tau} = \ln 0,01$

$-\frac{t}{\tau} = -4,6 \Rightarrow$ $t = 4,6\tau.$ $= 4,6.10^{-3}\,s$

* $q = 0,999\, q_{max} \Leftrightarrow C.U_C = 0,999 C E$

$C E (1 - e^{-t/\tau}) = 0,999\, C.E$

$1 - e^{-t/\tau} = 0,999 \Rightarrow e^{-t/\tau} = 0,001$

$\ln(e^{-t/\tau}) = \ln(0,001) = -6,9$

$-t/\tau = -6,9 \Leftrightarrow$ $t = 6,9\tau = 6,9.10^{-3}\,s$