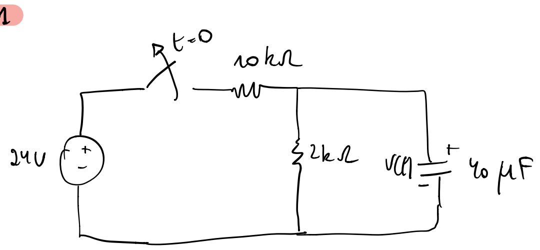
TP5:

Exercice 1



① Quand $t \leq 0$:

La capacité est chargée et agit comme un circuit ouvert $\Leftrightarrow$ $i_c = 0$

$V(t)$ pour $t<0$:

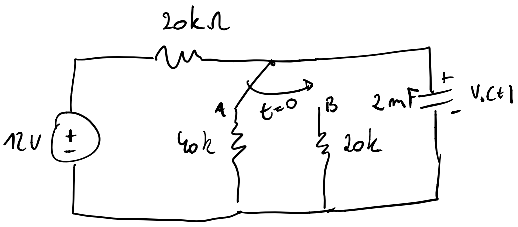
$V(t) = \frac{2}{10+2}(24) = 4\,V$

② Quand $t>0$:

$V(0) = 4\,V$ et $v(t) = V(0) \cdot e^{-t/\tau}$ où $\tau = R \cdot C = (10 \,//\, 2) \cdot 40 \cdot 10^{-6} = 66,67$

$V(t) = 4 \cdot e^{-t/66,67}$.

Exercice 2 :



Quand $t \leq 0$:

$V_o(0) = \frac{40}{40+20} \cdot 12 = 8\,V$

Quand $t>0$:

- V_o Quand la capacité se stabilisera $\Leftrightarrow$ $t \to +\infty$?

  $V_o(\infty) = \frac{20}{40} \cdot 12 = 6\,V$.

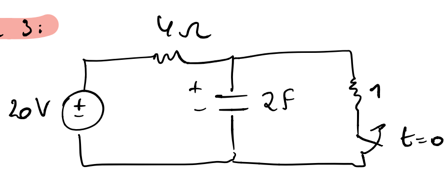
- $\tau = ?$

  $R_{th} = 20 \,//\, 20 = 10\,k\Omega$ $\Leftrightarrow$ $\tau = 10 \cdot 2 = 20\,s$

Finalement :

$V_o(t) = V_o(\infty) + [V_o(0) - V_o(\infty)]\, e^{-t/\tau} = 6 + 2 \cdot e^{-t/20}$

Exercice 3 :



a) Quand $t \leq 0$:

$v(t) = \frac{1}{5}(20) = 4\,V$

Quand $t > 0$:

$$v(t) = v(\infty) + [v(0) - v(\infty)]\, e^{-t/\tau} \qquad \tau = RC = 4 \cdot 2 = 8\,s$$

$v(+\infty)$?

La capacitée chargée $\Leftrightarrow$ $i_C = 0$ $\Leftrightarrow$ la capacité devient un circuit ouvert.

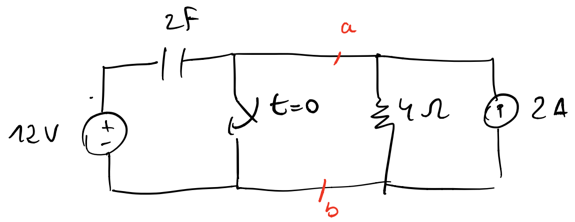
La différence aux bornes de la cap. $= 20V$ car pas de courant donc pas de ddp aux bornes de la résistance.

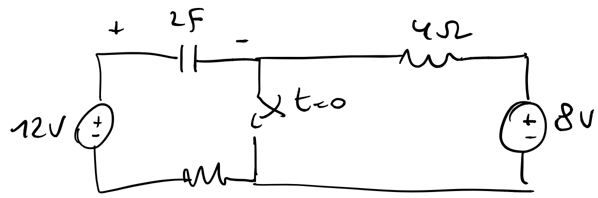
$$v(+\infty) = 20V$$

Finalement

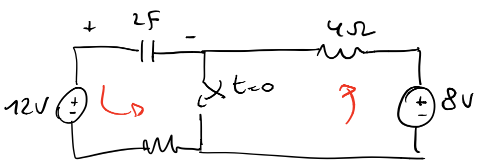
$$v(t) = 20 + (4 - 20)\, e^{-t/8} = 20 - 16 \cdot e^{-t/8}$$

b)





Quand $t \leq 0$:

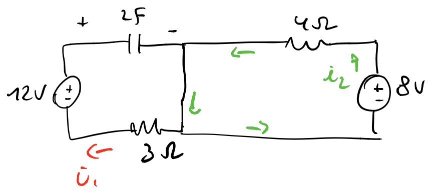


De nouveau la capacité agit comme un circuit ouvert, le courant dans la boucle $= 0$ donc la ddp aux bornes des résistance $= 0$

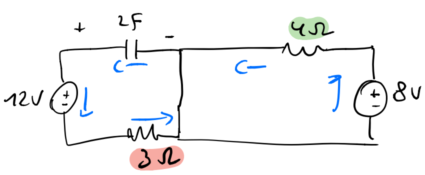
$$v(0) - 12 + 8 = 0 \Leftrightarrow v(0) = 4\,V.$$

Quand $t > 0$:

$v(+\infty) = $?



La capacité agit comme un circuit ouvert $\Leftrightarrow$ $i_1 = 0$ et $i_2 = \frac{8}{4} = 2\,A$.



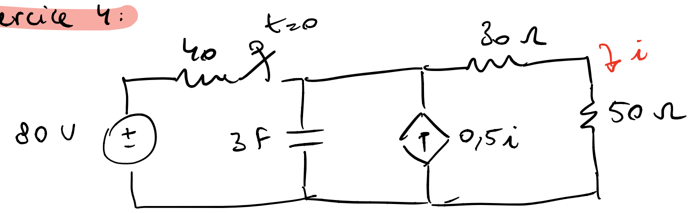
Sur la boucle,

$$\underbrace{8 - 8}_{i_2 \text{ dans } 4\,\Omega} + v(+\infty) - 12 + \underbrace{0}_{i_1 = 0} = 0 \Leftrightarrow v(+\infty) = 12V$$

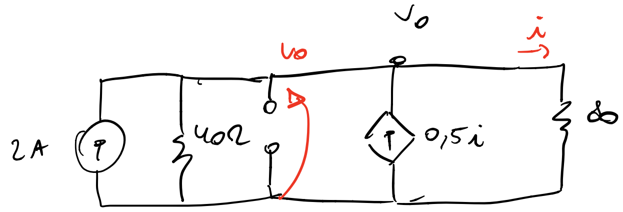
Finalement :

$$V(t) = 12 - 8\, e^{-t/6}$$

Exercice 4 :



Quand $t \leq 0$:

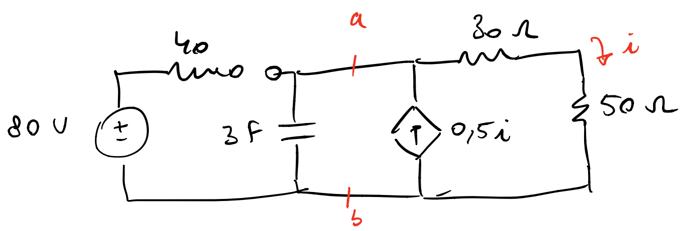


$$\begin{cases} 2 + 0,5i = \dfrac{V_0}{40} + \dfrac{V_0}{80} \\ i = \dfrac{V_0}{80} \end{cases}$$

$V(0) = 64V$

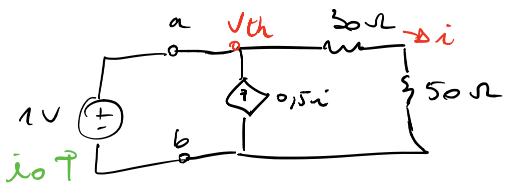
$\Leftrightarrow V_0 = 64V$

Quand $t > 0$:



On cherche R, il faut trouver l'éq Th.

Attention sources contrôlées.



$i = \dfrac{V_{th}}{80} = \dfrac{1}{80}$, $i_0 = 0,5i = \dfrac{0,5}{80}$

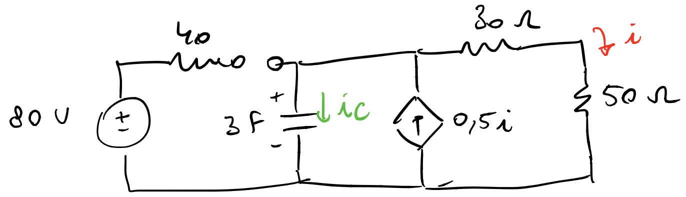
$R_{th} = \dfrac{1}{i_0} = \dfrac{80}{0,5} = 160\ \Omega$.

$\tau = ?$

$\tau = R_{th} \cdot C = 480$

$V_c(0) = 64V$ et $V_c(+\infty) = 0\ V$ $\Leftrightarrow$ $V_c(t) = 64 \cdot e^{-t/480}$

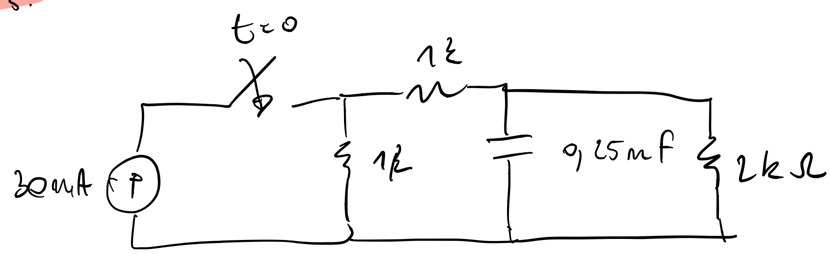
$i = ?$



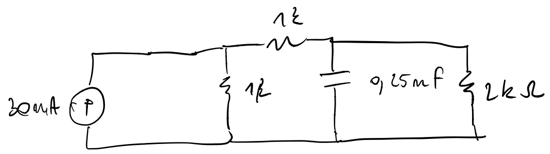
$$0{,}5i = -i_C = -C\frac{dV}{dt} = -3\cdot\left(\frac{-1}{480}\right)64\cdot e^{-t/480}$$

$$i(t) = -0{,}8\cdot e^{-t/480}\ A$$

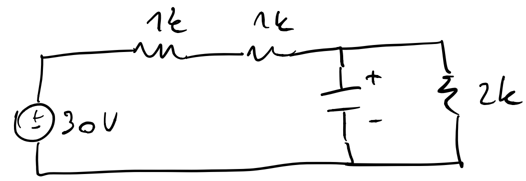
Exercice 5:



Quand $t > 0$:



$\Leftrightarrow$

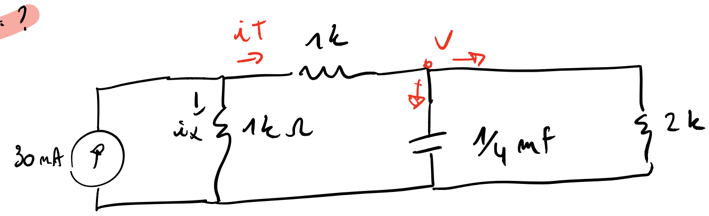


$$V(+\infty) = \frac{2}{2+1+1}\cdot 30 = 15\ V$$

$$R_{th} = (1+1)\,//\,2 = 1\ k\Omega \Leftrightarrow \tau = \frac{1}{4}\ s$$

$$V(t) = 15\cdot\left(1 - e^{-4t}\right)$$

$i_x = ?$



$$i_x = 30\ mA - i_T \quad \text{où} \quad i_T = \frac{V}{2k} + C\frac{dV}{dt} \quad \text{où} \quad V = V(t)$$

$$i_T = 7{,}5\cdot(1-e^{-4t}) - \frac{1}{4}\cdot 10^{-3}\cdot(-15)\cdot(-4)\,e^{-4t}\,A = 7{,}5\left(1 - e^{-4t}\right)\ mA$$

Donc

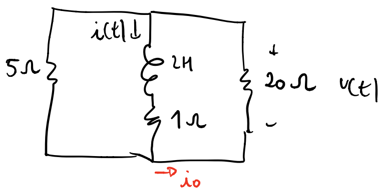
$$i_x = 30 - i_T = 7{,}5\cdot\left(3 - e^{-4t}\right)\ mA$$

TP 6:

Rappel : $V_L = L \dfrac{dI_L}{dt} = \frac{1}{2} L I_L^2$ et $I_L(t) = A + B e^{-t/\tau}$ où $\tau = \dfrac{L}{R_s}$

exercice 1 :

$i(0) = 10\,A.$



$$\tau = \frac{L}{R_{eq}} = \frac{L}{(5//20)+1} = \frac{2}{5}$$

$$i(t) = i(0) + e^{-t/\tau} = 10 \cdot e^{-2,5t}\,A$$

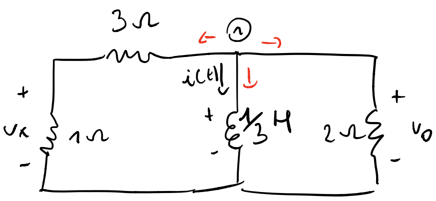
$v(t) = ?$ On peut utiliser le diviseur de courant.

$$i_o = \frac{5}{5+20} \cdot (i) = \frac{i}{5} = 2 \cdot e^{-2,5t}$$

$\Rightarrow$ $v(t)$ est mesurée dans le sens opposé de i_o, i_o ne va pas du + vers le −

$$\Leftrightarrow \; -V(t) = R \cdot i_o = 20 \cdot 2 \cdot e^{-2,5t} \Leftrightarrow v(t) = -40\, e^{-2,5t}$$

exercice 2 :



$V_o(0) = 2V$ $\qquad V_L(t) = \frac{1}{2} L I_L^2$

Au noeud 1 à $t = 0$:

$$i(0) + \frac{2}{2} + \frac{2}{4} = 0 \Leftrightarrow i(0) = -1,5$$

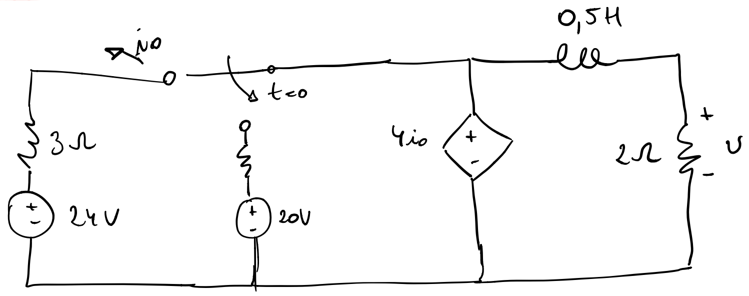
$$R_{eq} = 4//2 = \frac{4}{3} \qquad \tau = \frac{L}{R_{eq}} = \frac{1/3}{4/3} = \frac{1}{4}$$

$$\Rightarrow i(t) = i(0) \cdot e^{-t/\tau} = -1,5 \cdot e^{-4t}, \quad t > 0$$

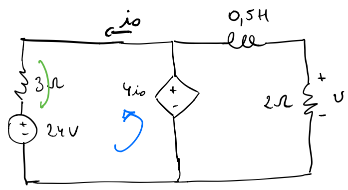
$$v_o(t) = \frac{1}{2} L \cdot \frac{d\,i(t)}{dt} = 2\,e^{-4t}\,V, \quad t > 0$$

$$v_x(t) = \frac{1}{3+1} V_L = 0,5\,e^{-4t}\,V, \quad t > 0$$

Exercice 3



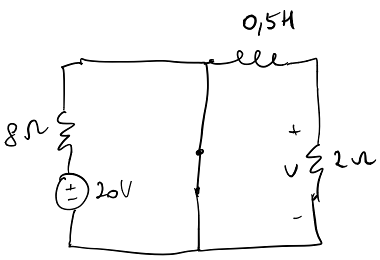
Pour $t < 0$:



Pour trouver i_o utilisez la boucle,

$$\underline{i_o \cdot 3\Omega} + 24V - 4 i_o = 0 \iff i_o = 24$$

$v(t) = ?$ En $t<0$; la ddp est nulle, lorsqu'une inductance est soumise à un courant continu, elle se comporte comme un fil.



$$v(t) = 4 i_o = 96V \iff i(t) = 48A \quad , t < 0$$

Pour $t \geq 0$, $i_o = 0$ donc les source de potentiel contrôlée est annulée.

$$i(t) = i(\infty) + (i(0) - i(\infty))\, e^{-t/\tau}$$

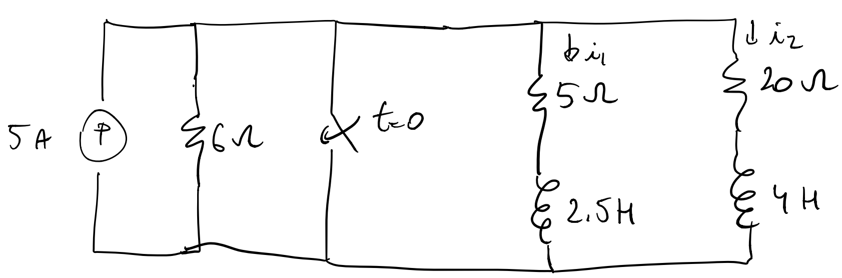
$i(0) = 48A$, $\quad i(\infty) = 0\ A \rightarrow$ tout le courant passe dans le court-circuit. (l'ancienne source de courant contrôlée).

$$R_{th} = 2\Omega \quad , \quad \tau = \frac{L}{R_{th}} = \frac{1}{4}$$

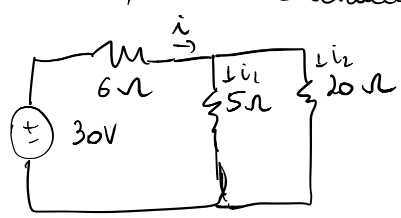
$$\Rightarrow i(t) = 48\, e^{-4t} \quad , \quad v(t) = 2\Omega \cdot i(t) = 96 \cdot e^{-4t}$$

Attention ici $v(t)$ désigne bien la ddp aux bornes de la résistance de 2Ω

Exercice 4 :

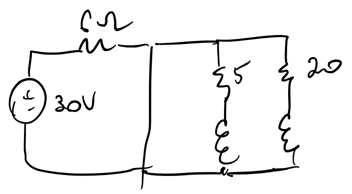


En $t = 0^-$, les inductances ont atteint un état stable, la ddp aux bornes est nulle.



$$i = \frac{30}{6 + 5//20} = \frac{30}{10} = 3A \quad , \quad i_1 = \frac{20}{25} \cdot 3 = 2.4 \quad , \quad i_2 = 0{,}6$$

En $t>0$, l'interrupteur est fermé, l'énergie de L_1 et L_2 se dissipe à travers les résistances de $5\,\Omega$ et $20\,\Omega$.



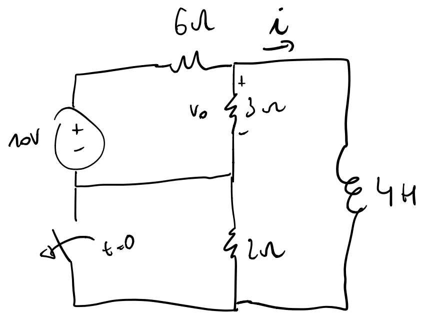
$$i_1(t) = i_1(0)\, e^{-t/\tau_1}, \qquad \tau_1 = \frac{L}{5} = \frac{2{,}5}{5} = \frac{1}{2}$$

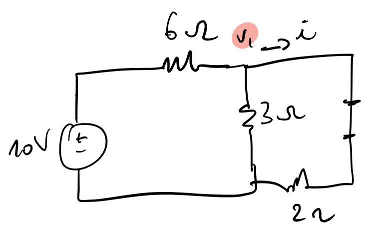
$$i_2(t) = i_2(0)\, e^{-t/\tau_2}, \qquad \tau_2 = \frac{L}{20} = \frac{4}{20} = \frac{1}{5}$$

$i_1(t) = 2{,}4\, e^{-2t}$ A

$i_2(t) = 0{,}6\, e^{-5t}$ A.

Exercice 5:





$t=0^-$ l'inductance est un court-circuit.

$i = \frac{10}{6} = 1{,}667$ A, $t<0$

$t>0$, $R = 2 + 3/\!/6 = 4\,\Omega$, $\tau = \frac{L}{R} = \frac{4}{4} = 1$

$i(+\infty) = ?$

$$\frac{10-V_1}{6} = \frac{V_1}{2} + \frac{V_1}{3} \longrightarrow V_1 = \frac{10}{6}$$

$i = i(\infty) = \frac{V}{2} = \frac{5}{6}$

$$i(t) = i(\infty) + [i(0) - i(\infty)]\, e^{-t/\tau} = \frac{5}{6}(1 + e^{-t})\ \text{A}$$

v_0 = la d.d.p aux bornes de la $R: 3\,\Omega$

$$= v_{R_{2\Omega}} + V_L = 2 \cdot i(t) + L \cdot \frac{di}{dt}$$

$$= \frac{10}{6} \cdot (1 + e^{-t}) + 4 \cdot \frac{-5}{6} \cdot e^{-t} = 1{,}667 \cdot (1 + e^{-t})\ \text{V}$$