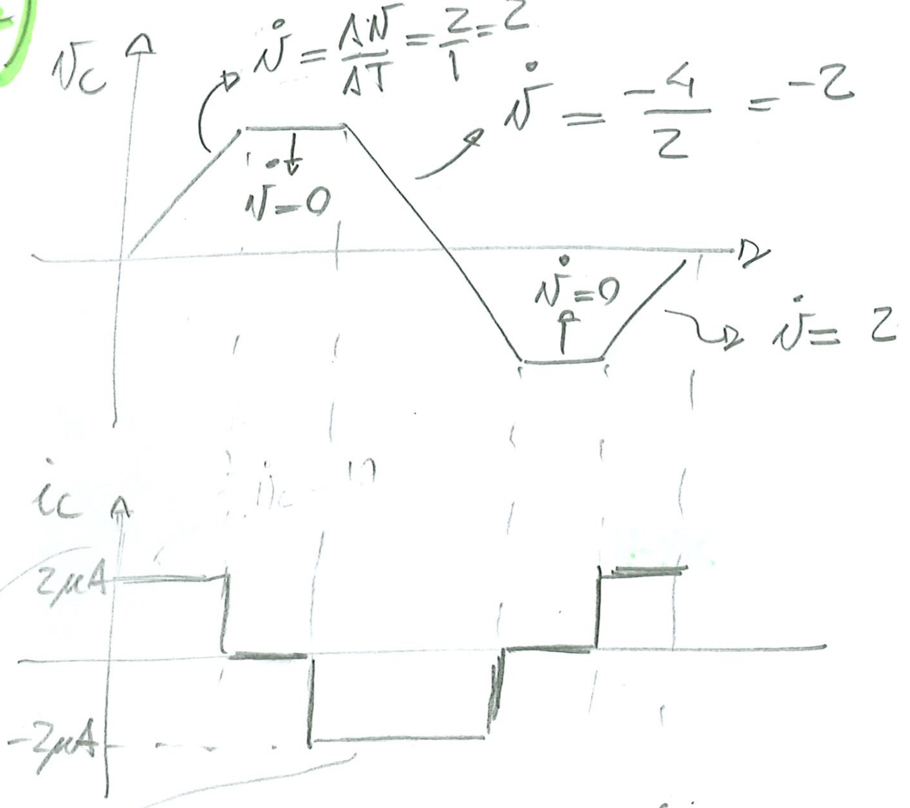
D 6 : Condensateurs

$$\boxed{i_c = C \cdot \dot{v}_c} \qquad \boxed{v_c = \frac{1}{C}\int i_c + v_c(0)}$$

$$\boxed{Q = C \cdot V}$$

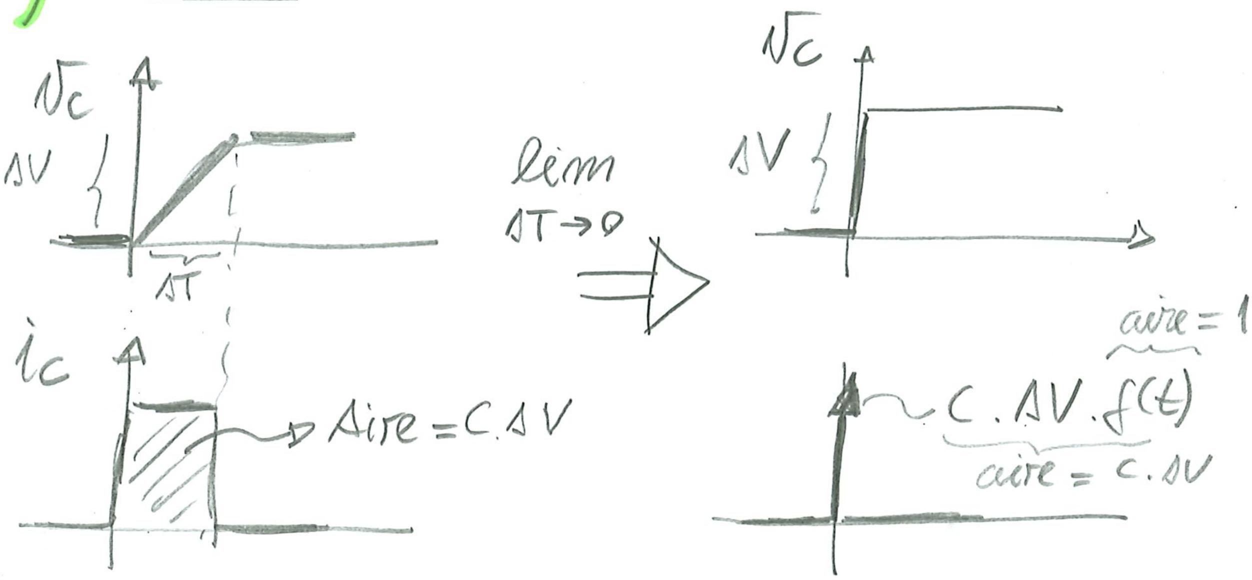
6.2 a)

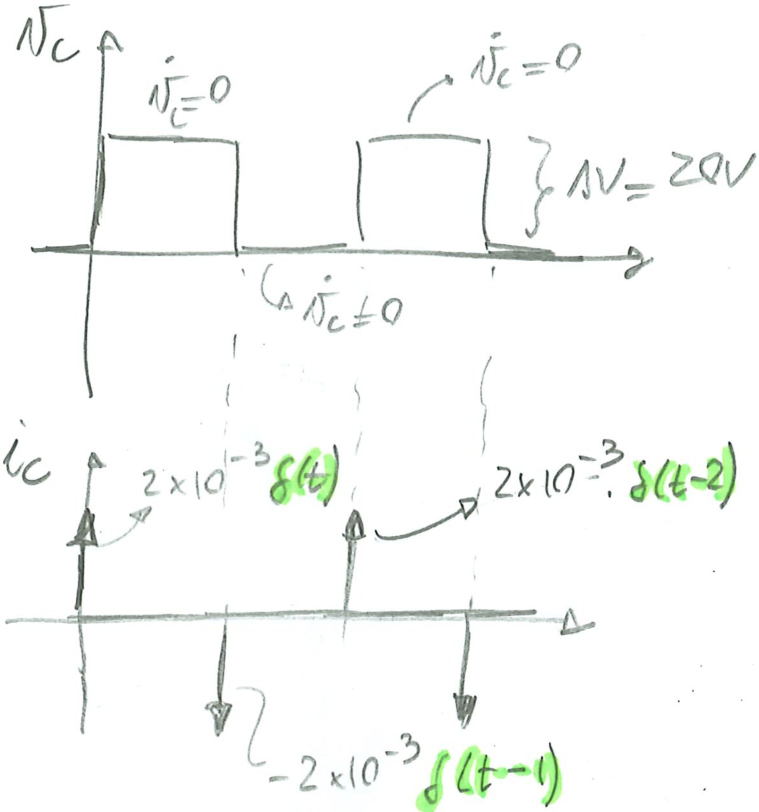


$i_c = C \cdot \dot{v}_c = 100 \times 10^{-6} \times 2 = 2\mu A$

$i_c = C\, \dot{v}_c = 100 \times 10^{-6} \times (-2) = -2\mu A$

6.2 c) Rappel :



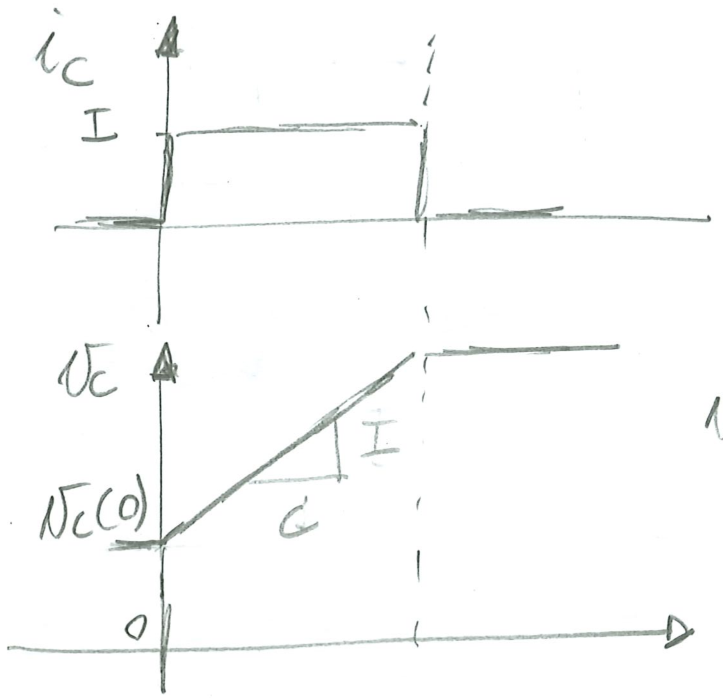


Aire sous le courant :

$$A = C.\Delta V = 100\times10^{-6}.20$$

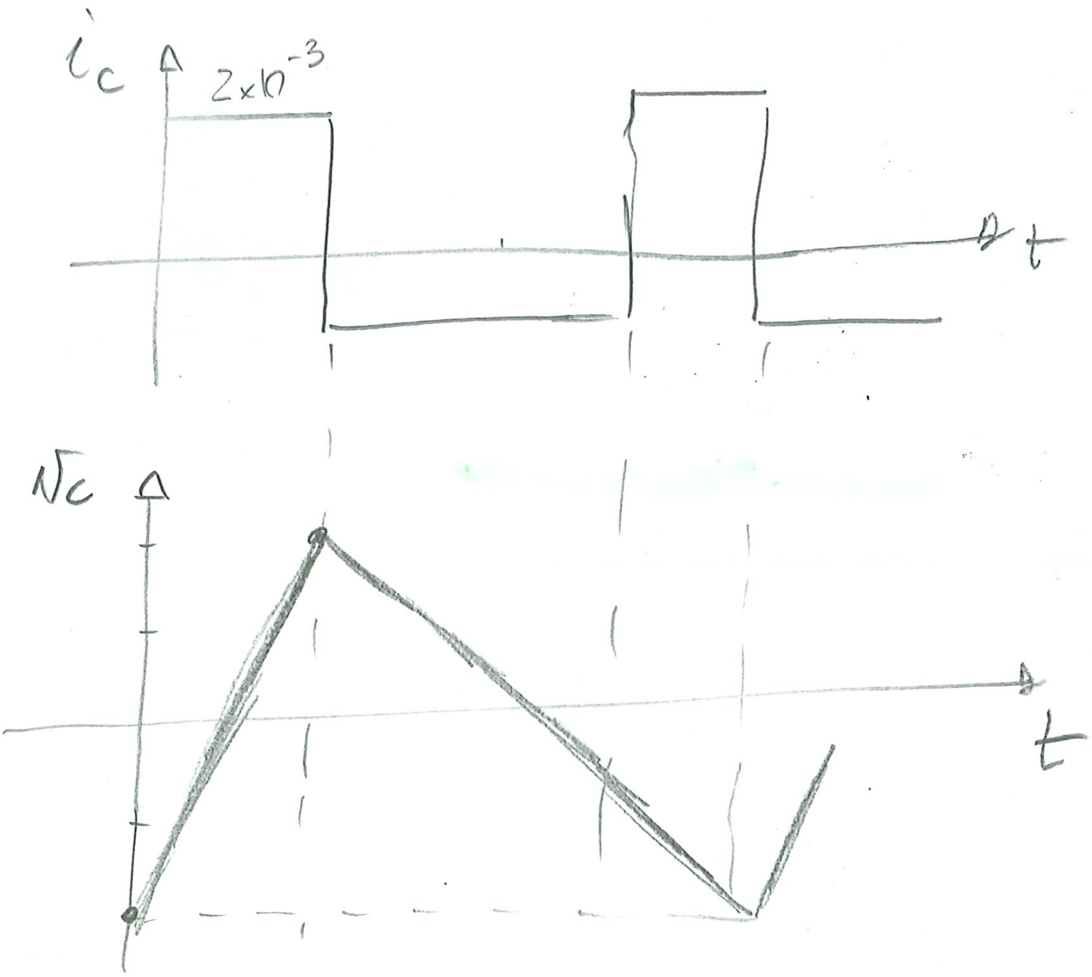
$$= 2\times10^{-3}\ A\times s$$

6.3 b) Rappel :



$$v_C = \frac{1}{C}\int_0^t I \, d\tau + v_C(0)$$

$$= \underbrace{\left(\frac{I}{C}\right)}_{\text{Pente } v_c \, = \, \frac{I}{C}} \cdot t + v_c(0)$$



$0 < t < 1$:

$$v_c = \frac{I}{C} \cdot t + v_c(0) = \frac{2\times10^{-3}}{100\times10^{-6}} \cdot t - 10$$

$$= \underline{20t - 10} \Rightarrow \text{À } t = 1s \Rightarrow \underline{v_c(1)} = 20 - 10$$

$$= \underline{10V}$$

——— × ———

$1 < t < 3$:

On déplace l'axe du temps

$t = 1sec \Rightarrow \Delta t = 0sec$

$$\underline{v_c} = \frac{I}{C} \Delta t + v_c(0)$$

$v_c(1s)$

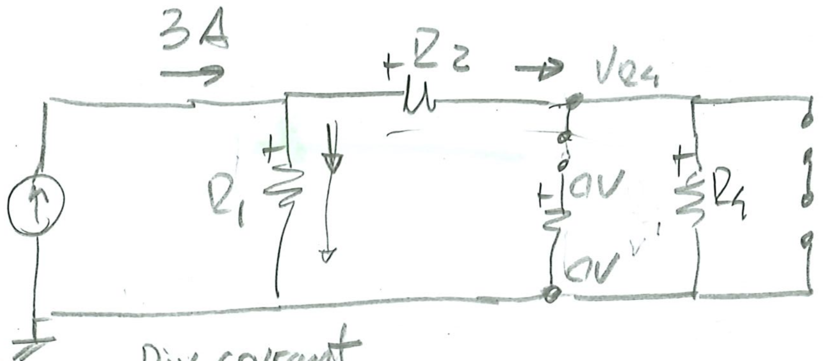
$$= \frac{-1\times10^{-3}}{100\times10^{-6}} \Delta t + 10$$

$$= \underline{-10\Delta t + 10} \Rightarrow \text{À } \Delta t = 2s \Rightarrow \underline{v_c(\Delta t = 2) = -10V}$$

——— × ———

6.7 c) C.C :
On enlève les C et on calcule le tensions.

— x —



Div. courant

$$I_{R_1} = \frac{R_2+R_4}{R_1+R_2+R_4} \times I_1 = \frac{12}{16} \cdot 3 = 2{,}25\,A$$

$$I_{R_4} = I_{R_2} = \frac{R_1}{R_1+R_2+R_4} I_1 = \frac{4}{16} \cdot 3 = 0{,}75\,A$$

$$\Rightarrow V_{R_4} = I_{R_4} \times R_4 = 0{,}75 \times 10 = 7{,}5\,V$$

$$V_{C_1} = V_{R_4} \left(\text{car } V_{R_3} = \underbrace{i_{R_3}}_{0} \times R_3 = 0\right)$$

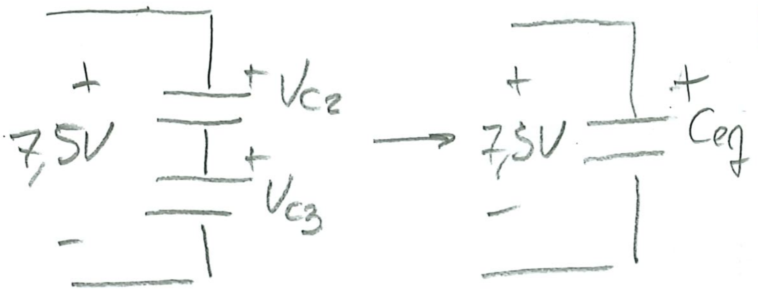
$$\boxed{V_{C_1} = 7{,}5\,V} \qquad Q_{C_1} = C_1 . V_1 = 2 \times 10^{-6} \times 7{,}5\,V$$

$$\boxed{Q_{C_1} = 15\,\mu C}$$

$$E_{C_1} = \frac{1}{2} C_1 V_1^2 = 56{,}25\,\mu J$$

$\underline{V_{C2}}, \underline{V_{C3}}$? $\longrightarrow$ C_2, C_3 : connexion série

$$\boxed{Q_{C2} = Q_{C3} = Q_{ceq}}$$



$$C_{eq} = \frac{C_2 C_3}{C_2 + C_3} = \frac{10\times10^{-6}\times 20\times10^{-6}}{30\times10^{-6}} = 6,\bar{6}\,\mu F$$

$$\Rightarrow Q = C_{eq}\cdot V = 6,\bar{6}\times10^{-6}\times 7,5 = 50\,\mu C$$

$$V_{C2} = \frac{Q_2}{C_2} = \frac{Q}{C_1} = \frac{50\times10^{-6}}{10\times10^{-6}} = 5V$$

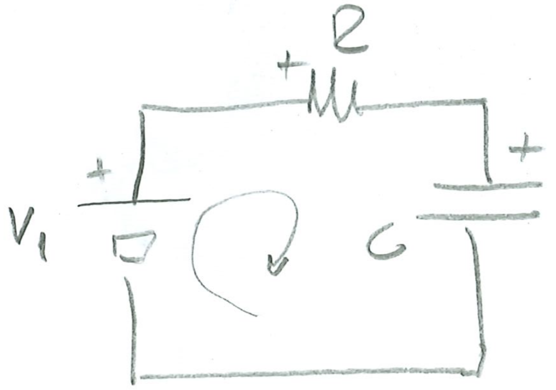
$$V_{C3} = \frac{Q}{C_3} = \frac{50\times10^{-6}}{20\times10^{-6}} = 2,5V$$

$$E_{C2} = \frac{1}{2} C_2 V_2^2 = \frac{1}{2}\times 10\times10^{-6}\times 5^2 = 125\,\mu J$$

$$E_{C3} = \frac{1}{2} C_3 V_3^2 = \frac{1}{2}\, 20\times10^{-6}\times 2,5^2 = 62,5\,\mu J$$

— x —

6.8) Circuit RC



LKT: $-V_1 + \underbrace{v_R}_{\underbrace{i_R \cdot R}_{i_C}} + v_C = 0$

$$v_C + R \cdot \underbrace{i_C}_{C \cdot \dot{v}_C} = V_1$$

$$\Rightarrow \boxed{v_C + R.C.\dot{v}_C = V_1}$$ Éq. diff. 1er ordre

Solution: $v_C(t) = \underbrace{v_{C(HOMOG)}(t)} + v_{C(PARTIC)}(t)$

- Résultat de l'éq homogène : $v_C + RC\dot{v}_C = 0$

Proposition: $v_{C_H}(t) = A.e^{\lambda t} \rightarrow \dot{v}_{C_H}(t) = A.\lambda e^{\lambda t}$

On a donc :

$$A e^{\lambda t} + RC A \lambda e^{\lambda t} = 0$$

$$\underbrace{A e^{\lambda t}}_{\neq 0} \underbrace{(1 + \lambda RC)}_{=0} = 0$$ → éq caractéristique

$$1 + \lambda RC = 0 \Rightarrow \boxed{\lambda = \frac{-1}{RC}}$$

Solution particulaire?

Si entrée V_1 = constante $\Rightarrow v_{Cp}(t) = K$

$$\Rightarrow \dot{v}_{Cp} = 0$$

$$\underbrace{v_{Cp}}_{K} + RC \underbrace{\dot{v}_{Cp}}_{0} = V_1$$

$$K + 0 = V_1 \Rightarrow \boxed{K = V_1}$$

Donc :

$$v_C = v_{CA} + v_{Cp} = A \cdot e^{-\frac{t}{RC}} + V_1$$

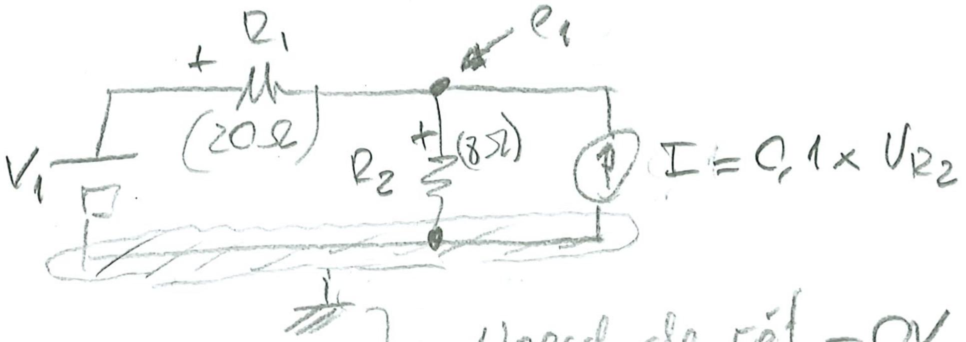
Pour calculer A, on doit se servir de la c.i :

$$v_C(0) = A \cdot \underbrace{e^{\frac{-0}{RC}}}_{1} + V_1 = 0 \Rightarrow A = -V_1$$

$$\Rightarrow \boxed{v_C(t) = V_1 \left(1 - e^{-\frac{t}{RC}}\right)}$$

6.9)

1_ **Régime C.C** : on retire le condensateur et on calcule les tensions.



↳ Noeud de réf = 0V

Méthode noeuds sur "e_1" :

$$\frac{V_1 - e_1}{R_1} - \frac{e_1}{R_2} + \underbrace{I}_{0{,}1 \times \underbrace{V_{R_2}}_{= e_1}} = 0$$

⇒

$$\frac{V_1 - e_1}{R_1} - \frac{e_1}{R_2} + 0{,}1 . e_1 = 0$$

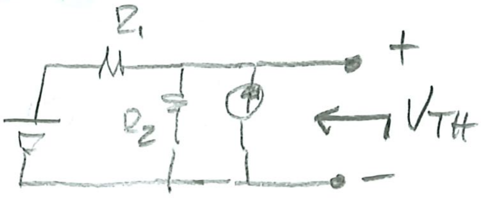
$$e_1 \left(-\frac{1}{R_1} - \frac{1}{R_2} + 0{,}1 \right) = -\frac{V_1}{R_1}$$

$$e_1 = \frac{\frac{V_1}{R_1}}{\frac{1}{R_1} + \frac{1}{R_2} - 0{,}1} = \frac{\frac{24}{20}}{\frac{1}{20} + \frac{1}{8} - 0{,}1} = 16\,V$$

$$\Rightarrow V_{C1} = e_1 = 16\,V$$

— x —

$$V_{TH} = V_{C_1} = e_1 = 16\,V$$



R_{TH} ?

Il y a une source dépendante

$\Rightarrow$ On doit :

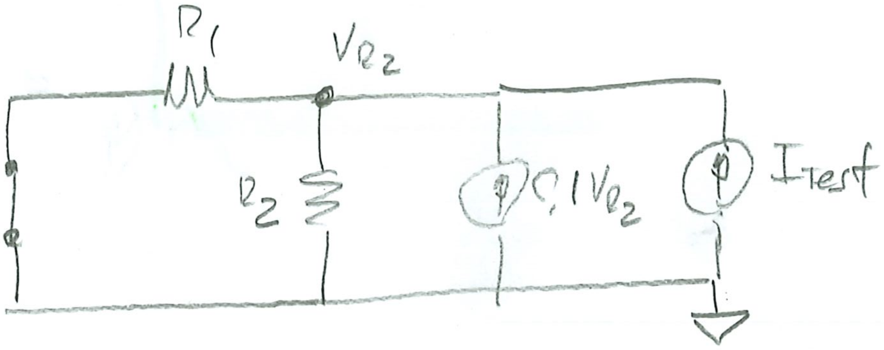
1) Neutraliser les sources indép (V_1)

2) On connecte une source de tension V_{test} et on calcule i_{test}

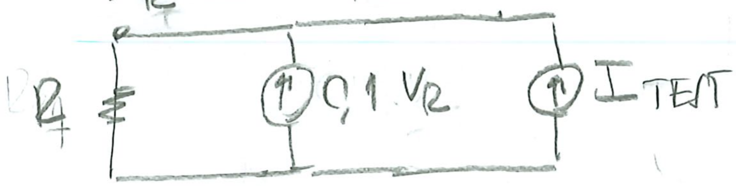
ou

On connecte une source de courant i_{test} et on calcule V_{test}

3) $R = \dfrac{V_{test}}{i_{test}}$



$V_R = V_{TEST}$



$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{20 \times 8}{28}$$

$$R_{THEV} = \frac{V_{TEST}}{I_{TEST}}$$

L.K.C : $I_R = I_{TEST} + 0{,}1 . \underbrace{V_R}_{=V_{TEST}}$

Loi d'Ohm sur R :

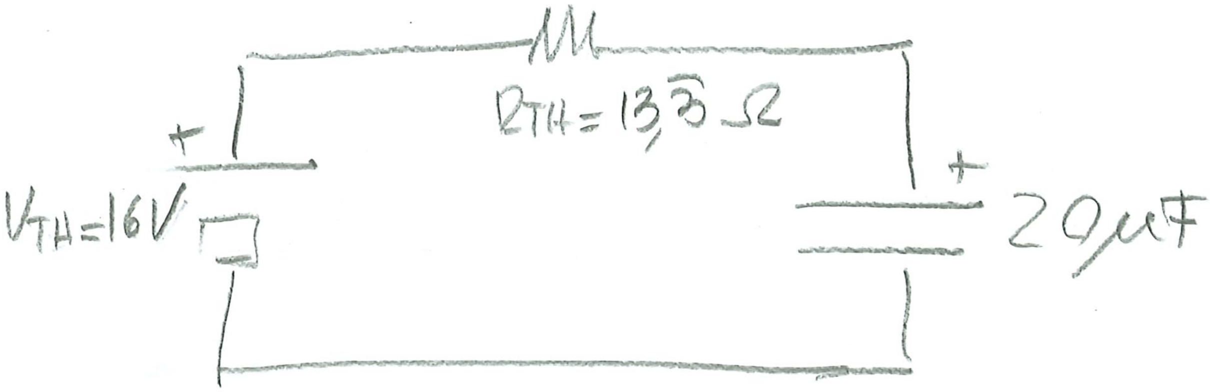
$$\underbrace{V_R}_{=V_{TEST}} = R . I_R$$

$$\Rightarrow V_{TEST} = R\left(I_{TEST} + 0{,}1 . V_{TEST}\right)$$

$$V_{TEST}\left(1 - 0{,}1R\right) = R\, I_{TEST}$$

$$\Rightarrow \boxed{\frac{V_{TEST}}{I_{TEST}} = \frac{R}{1 - 0{,}1R} = R_{THEVENIN}}$$

$$\boxed{R_{TH}} = \frac{\frac{20\times 8}{28}}{1-0{,}1\,\frac{20\times 8}{28}} = \boxed{13{,}333\ \Omega}$$



$$\lambda = R_{TH}\,C = 266{,}6\ \mu s$$

$$\Rightarrow \boxed{v_c(t) = 16\left(1 - e^{\frac{-t}{266{,}66\times 10^{-6}}}\right)\ (V)}$$