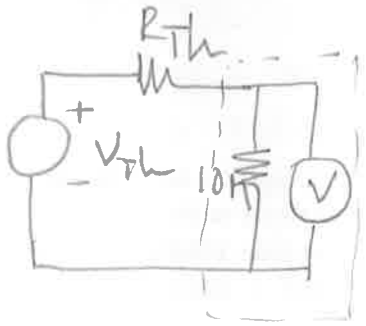
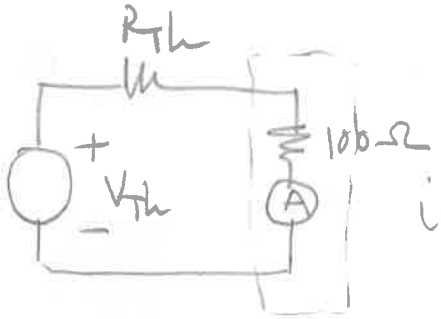
2014/15

1º TESTE (8 Abril)

(1)



$V = 5V$



$i = 25\,mA$

$$5V = \frac{10M}{R_{Th}+10M} V_{Th} \qquad 25\,mA = \frac{V_{Th}}{R_{Th}+100\,\Omega}$$

VAMOS COMEÇAR POR <u>ADMITIR</u> QUE $R_{Th} \ll 10\,M\Omega$

NESTE CASO SERÁ:

$$\frac{10M}{R_{Th}+10M} \simeq 1 \Rightarrow V_{Th} = 5V$$

$$R_{Th} + 100\,\Omega = \frac{5V}{25\,mA} \Rightarrow R_{Th} = \frac{5}{25\times10^{-3}} - 100\,\Omega$$

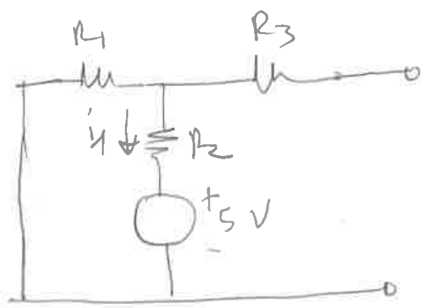
$$= 200\,\Omega - 100\,\Omega$$

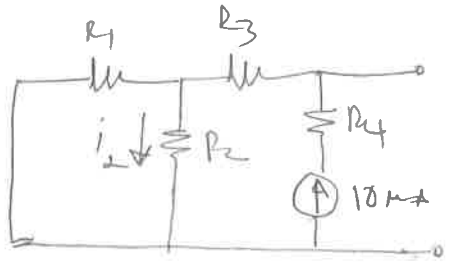
$$= 100\,\Omega$$

COMO O RESULTADO ($R_{Th} = 100\,\Omega$) É COERENTE COM A SUPOSIÇÃO INICIAL ($R_{Th} \ll 10\,M\Omega$):

$$\begin{cases} V_{Th} = 5V \\ R_{Th} = 100\,\Omega \end{cases}$$

(2) a) SERÁ $i = i_1 + i_2$ COM:





DETERMINAÇÃO DE i_1':

$$i_1' = -\frac{5V}{(R_1+R_2)} = -\frac{5V}{1220\,\Omega} = -4{,}1\,mA$$

↳ (PORQUE DEFINIMOS COMO POSITIVA A CORRENTE QUE <u>ENTRA</u> NO TERMINAL + DA FONTE DE TENSÃO)

DETERMINAÇÃO DE i_2':

A CORRENTE i_2' É A CORRENTE QUE PASSA EM R_2 COMO RESULTADO DA DIVISÃO DOS 10 mA ENTRE AS RESISTÊNCIAS R_1 e R_2

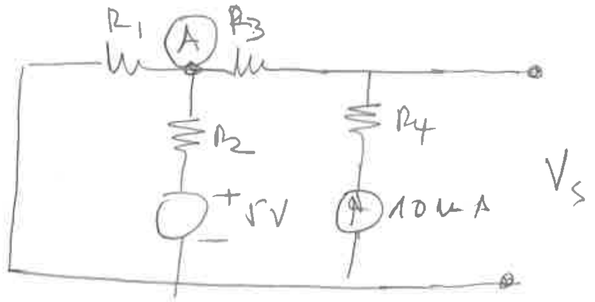
$$i_2' = \frac{R_1}{R_1+R_2} \times 10\,mA = \frac{220}{1220} \times 10\,mA \simeq 1{,}8\,mA$$

A CORRENTE EM R_2 É PORTANTO:

$$i' = i_1' + i_2' = -4{,}1\,mA + 1{,}8\,mA = -2.3\,mA$$

É UMA CORRENTE DE 2,3 mA QUE SAI DO TERMINAL + DA FONTE DE TENSÃO

b)



$$V_S = V_A + V_{R_3} =$$
$$= V_A + R_3 \times 10\,mA =$$
$$= V_A + 2{,}2\times10^{3} \times 10\times10^{-3} =$$
$$= V_A + 22V$$

$$V_A = 5V - i R_2$$
$$= 5V - 2{,}3\times10^{-3} \times 1\times10^{3} =$$
$$= 2{,}7\,V$$

$$\boxed{V_S = 2.7\,V + 22V = 24.7\,V}$$

c) $V_{FC} = V_S + R_4 \times 10\,mA$

$= 24.7\,V + 1\,k\Omega \times 10\,mA = 34.7\,V$

d) $V_{Th} = V_S = 34{,}7\,V$

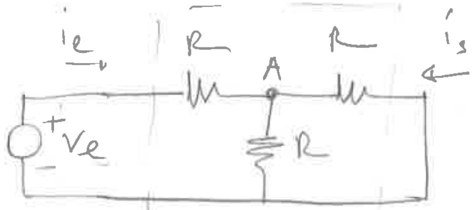
$R_{Th} = R_3 + (R_1 \| R_2) = 2{,}2\,k\Omega + \frac{0{,}22 \times 1}{0{,}22 + 1}\,k\Omega \simeq 2{,}4\,k\Omega$

e) $i_N = \frac{V_{Th}}{R_{Th}} = \frac{34.7\,V}{2{,}4\,k\Omega} = 14.4\,mA$

$R_N = R_{Th} = 2{,}4\,k\Omega$

3) $\begin{bmatrix} i_e \\ i_s \end{bmatrix} = \begin{bmatrix} Y \end{bmatrix} \begin{bmatrix} v_e \\ v_s \end{bmatrix}$

condição $V_S = 0 \Rightarrow$



$$\begin{cases} i_e = Y_{11} v_e + Y_{12} v_s \\ i_s = Y_{21} v_e + Y_{22} v_s \end{cases}$$

$Y_{11} = \left.\frac{i_e}{v_e}\right|_{V_S = 0}$

$Y_{12} = \left.\frac{i_e}{v_s}\right|_{V_e = 0}$

$Y_{21} = \left.\frac{i_s}{v_e}\right|_{V_S = 0}$

$Y_{22} = \left.\frac{i_s}{V_s}\right|_{V_e = 0}$

$Y_{11} = \left.\frac{i_e}{V_e}\right|_{V_S=0} = \frac{1}{R + (R\|R)} = \frac{1}{R + \frac{R}{2}} = \frac{1}{\frac{3R}{2}} = \frac{2}{3R}$

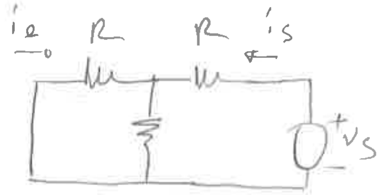
$Y_{21} = \left.\frac{i_s}{V_e}\right|_{V_S=0}$

$V_A = \frac{R\|R}{R + (R\|R)} V_e = \frac{R/2}{3R/2} V_e = \frac{1}{3} V_e$

$i_s = -\frac{V_A}{R} = -\frac{V_e}{3R}$

$Y_{21} = -\frac{V_e/3R}{\cancel{V_e}} = -\frac{1}{3R}$

condição $V_e = 0 \Rightarrow$

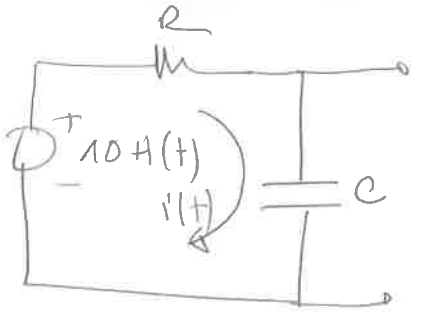


$Y_{22} = Y_{11} = \frac{2}{3R}$

$Y_{12} = \left.\frac{i_e}{V_S}\right|_{V_e=0} = Y_{21} = -\frac{1}{3R}$

$$\begin{bmatrix} Y \end{bmatrix} = \begin{bmatrix} \frac{2}{3R} & -\frac{1}{3R} \\ -\frac{1}{3R} & \frac{2}{3R} \end{bmatrix}$$

④



$$i(t) = \frac{V_0}{R} e^{-t/RC}$$

a)

$$V_s(t) = V_c(t) = V_0 - V_R(t) = V_0 - \cancel{R} \times \frac{V_0}{\cancel{R}} e^{-t/RC} = V_0\left(1 - e^{-t/RC}\right)$$

$$\frac{V_s(t)}{V_0} = 1 - e^{-t/RC} \Rightarrow e^{-t/RC} = \left(1 - \frac{V_s(t)}{V_0}\right)$$

$$-\frac{t}{RC} = \ln\left[1 - \left(\frac{V_s(t)}{V_0}\right)\right]$$

$$t = -RC \ln\left[1 - \left(\frac{V_s(t)}{V_0}\right)\right]$$

$$t = -10^3 \times 10^{-6} \ln(1 - 0,3) = 0,36\ \text{ms}$$

b)

$$\frac{R\,i(t)}{V_0} = e^{-t/RC} \Rightarrow -\frac{t}{RC} = \ln\left(\frac{R\,i(t)}{V_0}\right)$$

$$t = -RC \ln\left(\frac{R\,i(t)}{V_0}\right)$$

$$t = -10^3 \times 10^{-6} \ln\left(\frac{\cancel{10^3} \times 2 \times \cancel{10^{-3}}}{10}\right) = 1,6\ \text{ms}$$

c)

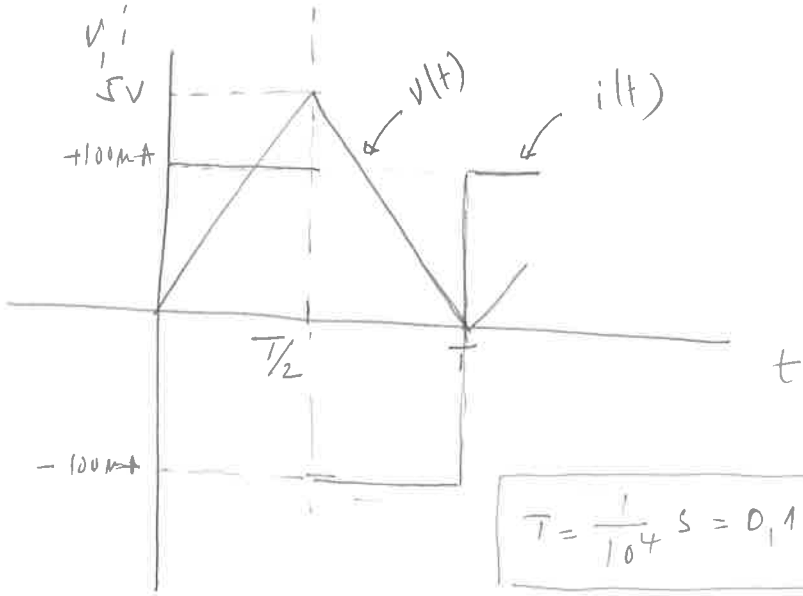
$$V_c(t) = \frac{1}{C}\int i(t)\,dt$$

$$= \frac{i_0}{C} t$$

$$= \frac{100 \times 10^{-3}}{10^{-6}} t$$

$$V_c(t = 0,05\ \text{ms}) = \cancel{10^5} \times 5 \times \cancel{10^{-5}}\ V$$

$$= 5\ V$$



$$\boxed{T = \frac{1}{10^4}\ s = 0,1\ \text{ms}}$$