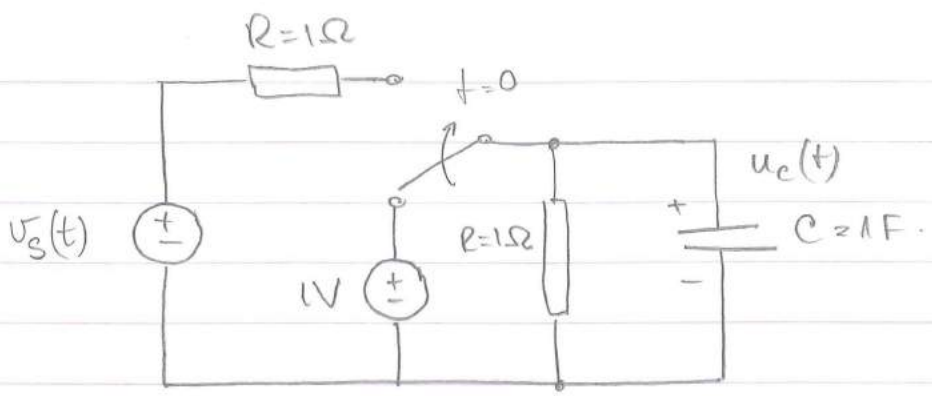
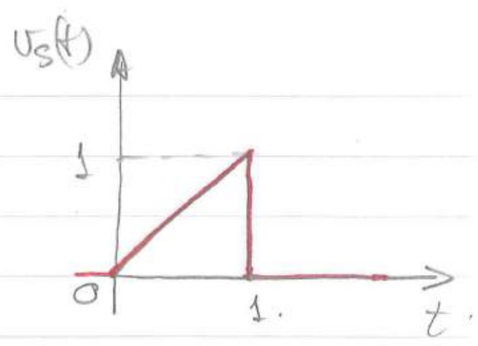




a) Determine $V_s(s) = \mathcal{L}\{v_s(t)\}$.

b) Determine $u_c(t)$.

a) $v_s(t) = t\,H(t) - t\,H(t-1)$

$= t\,H(t) - (t-1)\,H(t-1) - H(t-1)$

0.5 points

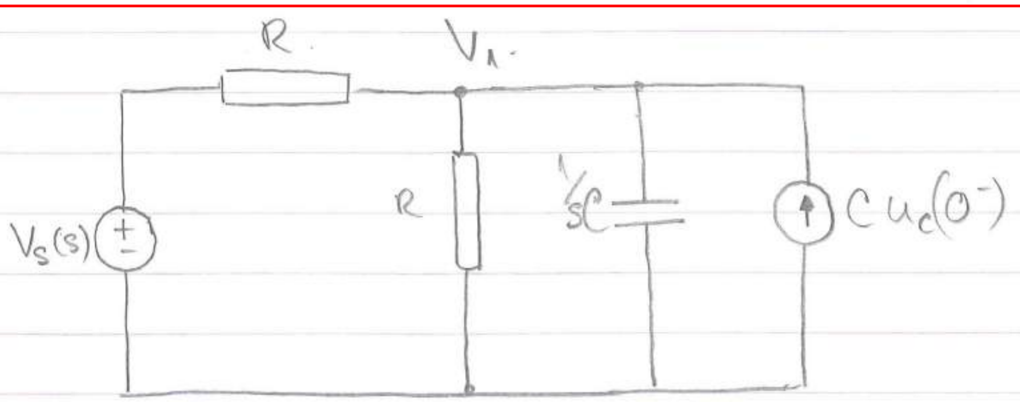
0.5 points

$$V_s(s) = \frac{1}{s^2} - \frac{1}{s^2}e^{-s} - \frac{1}{s}e^{-s} = \frac{1-e^{-s}-se^{-s}}{s^2} \quad (V.s)$$

b) Initial conditions.

$u_c(0^-) = 1\ V$

0.05 points



0.15 points

$$\frac{V_1 - V_S}{R} + \frac{V_1}{R} + sCV_1 = Cu_c(0^-)$$

$$V_1(2 + sRC) = RCu_c(0^-) + V_S \Rightarrow V_1(2+s) = V_S + 1$$

$$V_1 = \frac{1}{2+s}\left[\frac{1-e^{-s}-se^{-s}}{s^2} + 1\right] = \frac{1+s^2-(1+s)e^{-s}}{s^2(2+s)} = U_c$$

$$\frac{1+s^2}{s^2(2+s)} = \frac{A}{s} + \frac{B}{s^2} + \frac{C}{2+s}$$

0.3 points

$$A(2s+s^2) + B(2+s) + Cs^2 = (A+C)s^2 + (2A+B)s + 2B = 1+s^2$$

$$\Downarrow$$

$$A + C = 1 \Rightarrow C = 1 - A = 5/4.$$

$$2A + B = 0 \Rightarrow A = -B/2 = -1/4$$

$$2B = 1 \Rightarrow B = 1/2$$

0.3 points

$$(A+C)s^2 + (2A+B)s + 2B = 1+s$$

$$\Downarrow$$

$$A + C = 0 \Rightarrow C = -1/4.$$

$$2A + B = 1 \Rightarrow A = 1/2(1-B) = 1/4$$

$$2B = 1 \Rightarrow B = 1/2$$

0.2 points

$$u_c(t) = \left[-1/4 + 1/2\,t + 5/4\,e^{-2t}\right]H(t) - \left[1/4 + 1/2(t-1) - 1/4\,e^{-2(t-1)}\right]H(t-1)$$

$$= \left[-1/4 + 1/2\,t + 5/4\,e^{-2t}\right]H(t) - \left[-1/4 + 1/2\,t - 1/4\,e^{-2(t-1)}\right]H(t-1)$$

2

$$H(s) = \frac{20\cdot(s+1)\cdot(s^2+230\cdot s+6000)}{(s+100)\,(s^2+150\cdot s+5000)}$$

(*) $s^2+230\cdot s+6000 = (s+200)\cdot(s+30)$

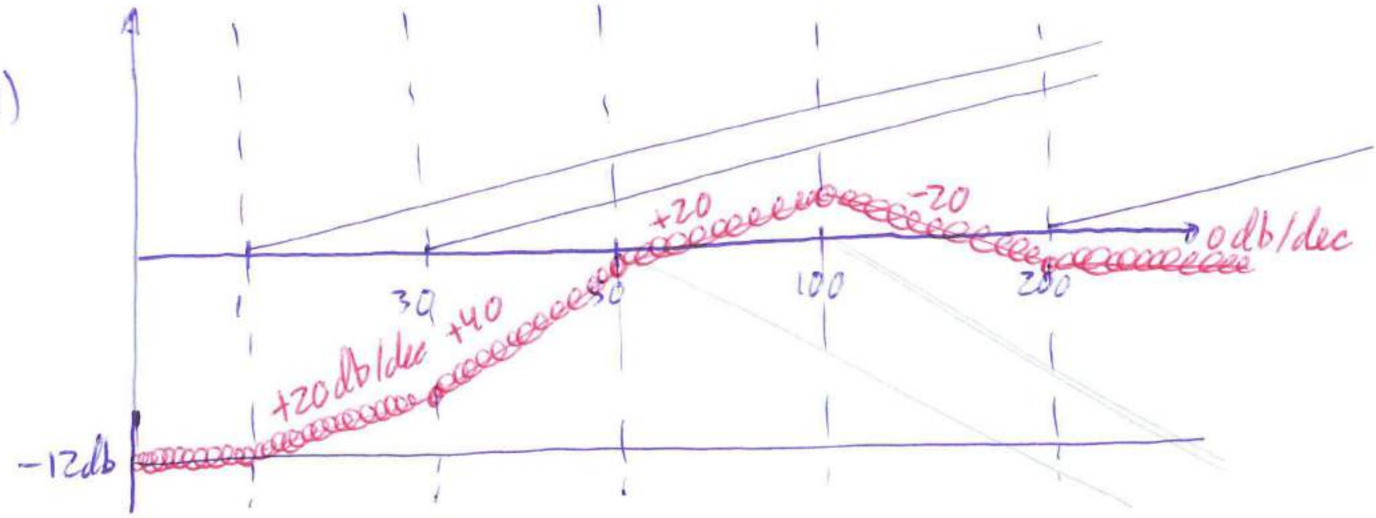
$$s = \frac{-230 \pm \sqrt{230^2-4\cdot 6000}}{2} = \frac{-230\pm 170}{2} = \begin{cases}-200\\-30\end{cases}$$

(*) $s^2+150\cdot s+5000 = (s+50)(s+100)$

$$s = \frac{-150 \pm \sqrt{150^2-4\cdot 5000}}{2} = \frac{-150\pm 50}{2} = \begin{cases}-100\\-50\end{cases}$$

$$H(s) = \frac{20\,(s+1)\,(s+30)\,(s+200)}{(s+50)\,(s+100)^2} = \frac{0'24\,(s+1)\cdot\left(\frac{s}{30}+1\right)\left(\frac{s}{200}+1\right)}{\left(\frac{s}{50}+1\right)\cdot\left(\frac{s}{100}+1\right)^2}$$

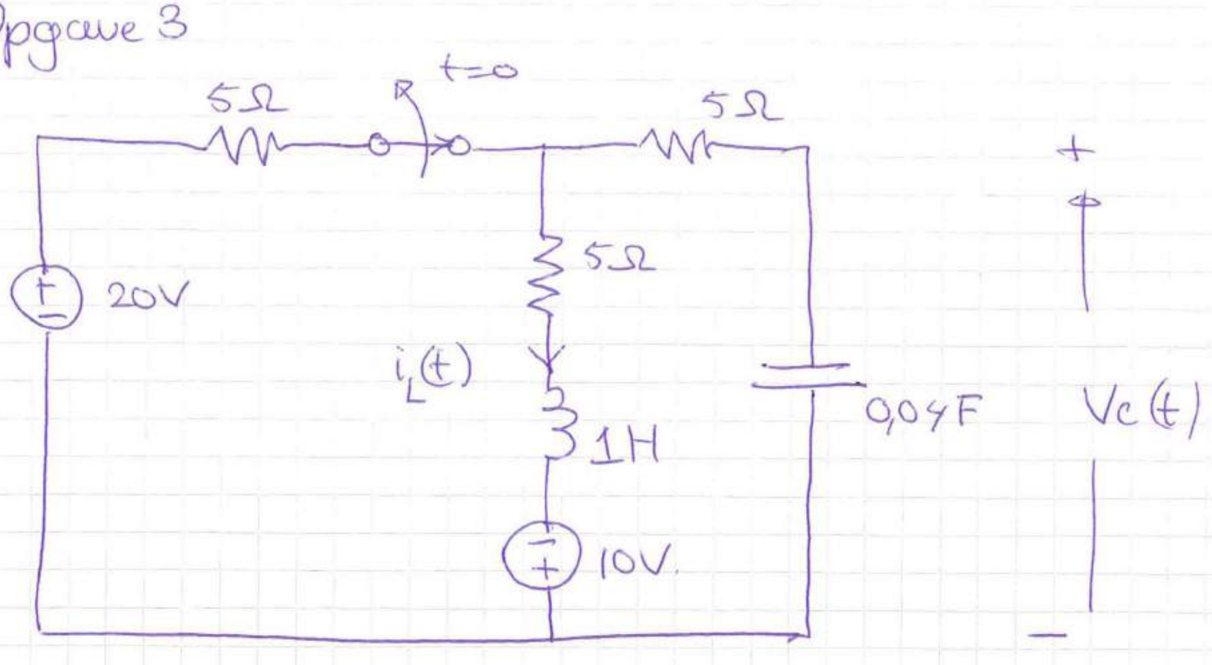
a)



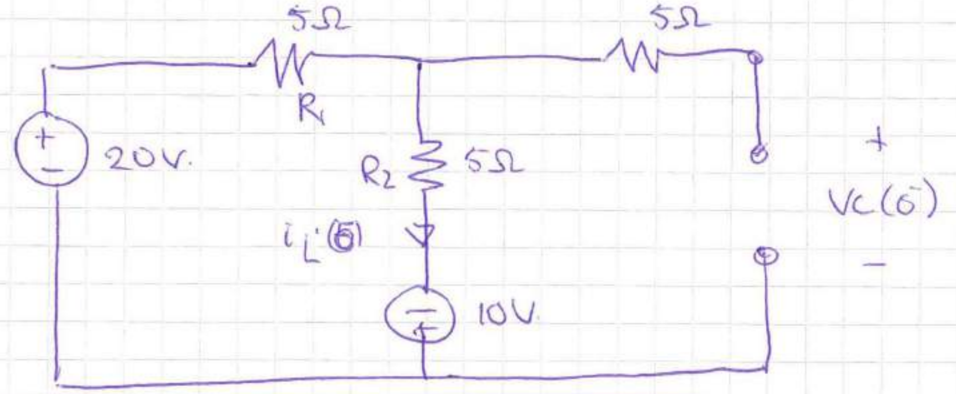
b) $|H(s)| \cong 20\cdot\log 0'24 = -12\text{ db} \quad \forall\, w < 1 \text{ rad/s}$

c) $$\left.|H(s)|\right|_{w\to\infty} = \lim_{w\to\infty} 20\cdot\log\left|\frac{20(jw+1)(jw+30)(jw+200)}{(jw+50)(jw+100)^2}\right| = 26\text{ db}$$

Opgave 3



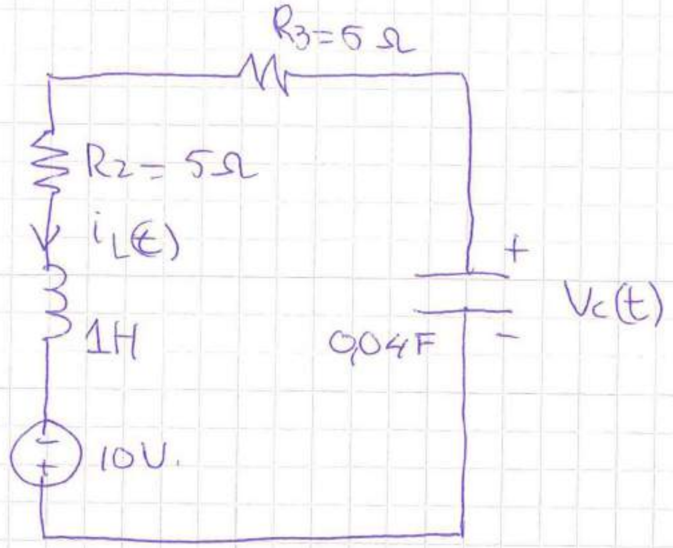
a) Beginvoorwaarden Vc(t) & $i_L(t)$ bij t=0.
Voor $t=0^-$



$$\boxed{i_L(0^-) = \frac{20+10}{R_1+R_2} = \frac{30}{10} = 3\,A}$$

$$\boxed{V_c(0^-) = -10 + 3 \cdot 5 = 5\,V}$$

b] Voor $t > 0$ s



De maasvergelijking voor $i_L(t)$ voor $t > 0$ s wordt:

$$\boxed{-10 - V_C(0^-) + \frac{1}{C}\int i_L(t)\,dt + i_L(t)\cdot(R_2 + R_3) + L\frac{d\,i_L(t)}{dt} = 0.}$$

c]

$$L\frac{d^2 i_L(t)}{dt^2} + (R_2 + R_3)\frac{d\,i_L(t)}{dt} + \frac{1}{C}i_L(t) = 0.$$

$$\frac{d^2 i_L(t)}{dt^2} + \frac{R_2 + R_3}{L}\frac{d i_L(t)}{dt} + \frac{1}{LC}i_L(t) = 0$$

$$\boxed{s^2 + 10s + 25 = 0.}$$

$$(s+5)(s+5) = 0.$$

$$\left.\begin{array}{l} S_1 = -5 \\ S_2 = -5 \end{array}\right\} \text{twee gelijk oplossingen.}$$

d] Twee gelijke oplossing dus <u>kritisch gedempt.</u>

Algemene oplossing voor $\boxed{i_L(t) = Ae^{-5t} + B\cdot te^{-5t} + C.}$

Met $C = 0$ want $i_L(t) = 0$ voor $t \to \infty$.

e] $i_L(t) = Ae^{-5t} + B \cdot t \cdot e^{-5t} \Rightarrow i_L(0) = A + B \cdot \phi = A$
$i_L(0^+) = i(0) = 3A \Leftarrow$ uit vraag a] $\Bigg\} \Rightarrow$

$A = 3.$

Maken we nu gebruik van de maasvergelijking uit b] dan vinden we.

$$\left.\begin{aligned} &15 = i_L(0^+)(R_2 + R_3) + L\frac{di_L(0^+)}{dt} \\ &\text{met } \frac{di_L(0^+)}{dt} = -5A + B. \\ &\text{en. } i_L(0^+) = 3 \end{aligned}\right\} \Rightarrow$$

$$15 = 3.(5+5) + 1.[-5A + B] \Rightarrow$$

$$\left.\begin{aligned} &15 = 30 + [-15 + B] \\ &\quad (\text{met } A = 3.) \end{aligned}\right\} \Rightarrow$$

$$15 = 15 + B \Rightarrow$$

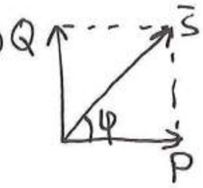
$$B = 0$$

$$\boxed{\text{Dus: } \quad i_L(t) = 3e^{-5t} \text{ A}}$$

$$\boxed{i_L(0{,}2196) = 3e^{-5 \cdot 0{,}2196} = \underline{\underline{1A}}}$$

a) De stroom loopt <u>achter</u> op de spanning (lagging / inductief).

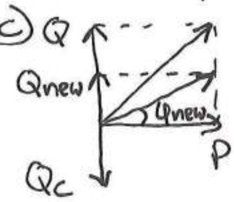
b)



$\cos\varphi = 0{,}4 \rightarrow \varphi = 66{,}42^\circ$

$\tan\varphi = \frac{Q}{P} \rightarrow \boxed{Q = P\tan\varphi = 916{,}52 \text{ VAR}}$

c)



$\varphi_{new} = \arccos(0{,}85) = 31{,}79^\circ$

$Q_{new} = P\tan\varphi_{new} = 247{,}9 \text{ VAR}$

$Q_C = Q_{new} - Q = -668{,}62 \text{ VAR}$

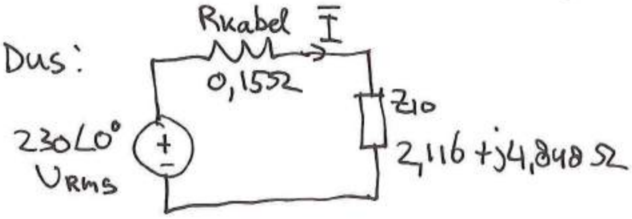
en ook: $Q_C = -\omega C V_{Rms}^2 \rightarrow \boxed{C = \frac{-Q_C}{\omega V_{Rms}^2} = 40{,}23\ \mu F}$

d) Eerst de impedantie van 1 belasting bepalen:

$\bar{S} = 400 + j916{,}52 \text{ VA}$ en $\bar{S} = \frac{V_{Rms}^2}{Z^*} \rightarrow Z = \frac{V_{Rms}^2}{\bar{S}^*} = 21{,}16 + j48{,}48\ \Omega$

10 belastingen parallel: $Z_{10} = \frac{Z}{10} = 2{,}116 + j4{,}848\ \Omega$

Dus:



$\bar{I} = \frac{\bar{V}}{Z_{tot}} = \frac{230\angle 0^\circ}{2{,}116 + j4{,}848 + 0{,}15}$

$\bar{I} = 18{,}197 - j38{,}934 \text{ A}_{Rms}$

Dus de kabelverliezen zijn: $\boxed{P_{kabel} = |\bar{I}|^2 R_{kabel} = 277{,}05 \text{ W}}$

e) $\cos\varphi = 0{,}85$ dus $\bar{S} = 400 + j247{,}9 \text{ VA}$

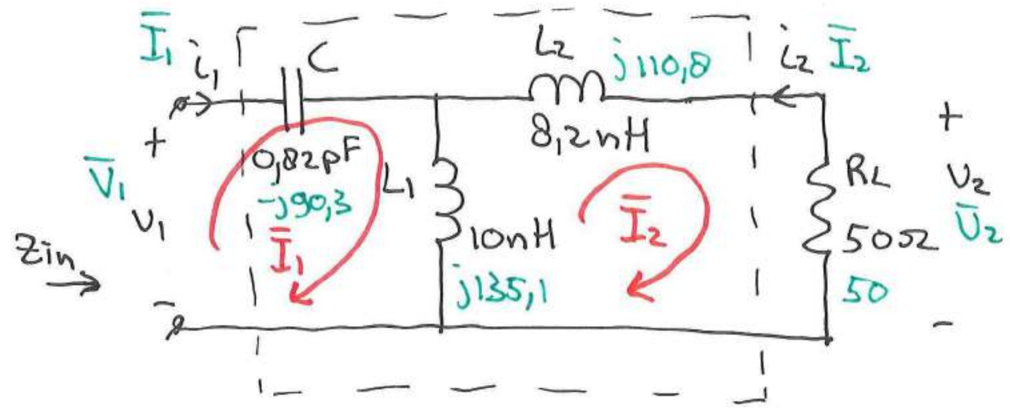
Impedantie 1 belasting: $Z = \frac{V_{Rms}^2}{\bar{S}^*} = 95{,}551 + j59{,}217\ \Omega$

Impedantie 10 belastingen: $Z_{10} = \frac{Z}{10} = 9{,}555 + j5{,}922\ \Omega$

De stroom $\bar{I}$: $\bar{I} = \frac{230\angle 0^\circ}{9{,}555 + j5{,}922 + 0{,}15} = 17{,}269 - j10{,}537 \text{ A}_{Rms}$

Dus de verliezen zijn nu: $\boxed{P_{kabel} = |\bar{I}|^2 R_{kabel} = 61{,}39 \text{ W}}$

 M. Pelk



$f = 2{,}15\ \text{GHz}$

a) $Z_C = \dfrac{1}{j\omega C} = -j90{,}3\ \Omega$

$Z_{L1} = j\omega L_1 = j135{,}1\ \Omega$

$Z_{L2} = j\omega L_2 = j110{,}8\ \Omega$

b) $\bar{I}_1$: $\bar{V}_1 = -j90{,}3\,\bar{I}_1 + j135{,}1(\bar{I}_1 - \bar{I}_2) \rightarrow \boxed{j44{,}8\,\bar{I}_1 - j135{,}1\,\bar{I}_2 = \bar{V}_1}$ ①

$\bar{I}_2$: $0 = j110{,}8\,\bar{I}_2 + 50\bar{I}_2 + j135{,}1(\bar{I}_2 - \bar{I}_1) \rightarrow \boxed{-j135{,}1\,\bar{I}_1 + (50 + j245{,}9)\bar{I}_2 = 0}$ ②

c) uit ② volgt $\bar{I}_2$: $\bar{I}_2 = \dfrac{j135{,}1\,\bar{I}_1}{50 + j245{,}9}$

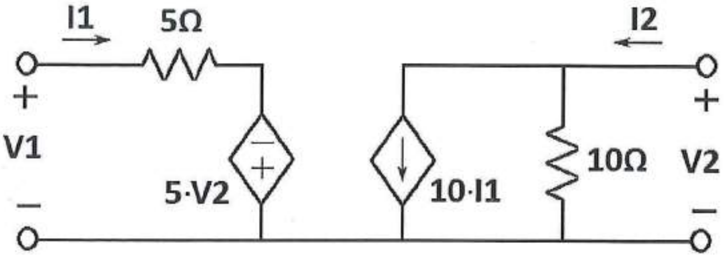
invullen in ①: $\bar{V}_1 = j44{,}8\,\bar{I}_1 + \dfrac{135{,}1^2}{50 + j245{,}9}\bar{I}_1$ $\qquad \bar{I}_1 = \bar{I}_1$

Dus: $Z_{in} = \dfrac{\bar{V}_1}{\bar{I}_1} = j44{,}8 + \dfrac{135{,}1^2}{50 + j245{,}9} = \boxed{14{,}49 - j26{,}48\ \Omega}$

d) $Z_{11} = \left.\dfrac{\bar{V}_1}{\bar{I}_1}\right|_{I_2 = 0} = -j90{,}3 + j135{,}1 = \boxed{j44{,}8\ \Omega}$

JANUARY 2014

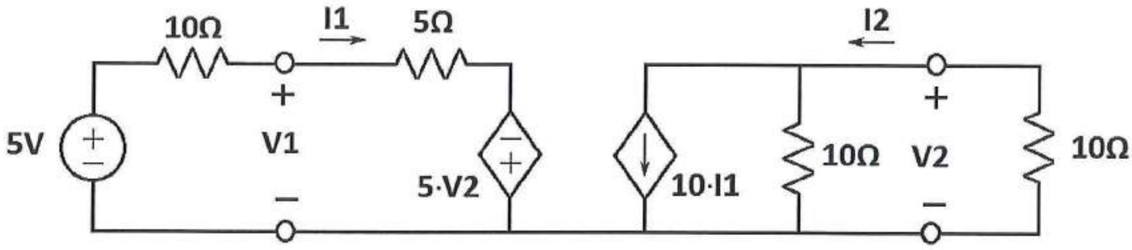
Qa) Calculate the *admittance parameters y* for the two-port network circuit in the following figure.



NOTE that: $I_1 = y_{11} \cdot V_1 + y_{12} \cdot V_2$

$I_2 = y_{21} \cdot V_1 + y_{22} \cdot V_2$

Qb) Using the calculated *admittance parameters y*, calculate the currents I1 and I2 for the following circuit.



a) $\boxed{Y_{11}}$ $V_2 = 0 \rightarrow Y_{11} = \frac{I_1}{V_1} = \frac{1}{5} = 0'2 \text{ S}$

$\boxed{Y_{12}}$ $V_1 = 0 \rightarrow Y_{12} = \frac{I_1}{V_2} = \frac{5V_2/5}{V_2} = 1 \text{ S}$

$\boxed{Y_{21}}$ $V_2 = 0 \rightarrow Y_{21} = \frac{I_2}{V_1} = \frac{2 \cdot V_1}{V_1} = 2 \text{ S}$

$I_1 = V_1/5 \rightarrow I_2 = 10 \cdot I_1 = 2 \cdot V_1$

$\boxed{Y_{22}}$ $V_1 = 0 \rightarrow Y_{22} = \frac{I_2}{V_2} = \frac{V_2/10 + 10V_2}{V_2} = 10 + 1/10 = 10'1 \text{ S}$

$I_1 = \frac{5V_2}{5} = V_2$

$I_2 = \frac{V_2}{10} + 10V_2$

$$Y = \begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix} = \begin{bmatrix} 0'2 & 1 \\ 2 & 10'1 \end{bmatrix}$$

$\boxed{b)}$ $$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} \rightarrow \begin{matrix} V_1 = 5 - 10 \cdot I_1 \\ V_2 = -10 I_2 \end{matrix}$$

$$I_1 = 0'2 \cdot V_1 + V_2 = 0'2(5 - 10 I_1) - 10 I_2 = 1 - 2 I_1 - 10 I_2 \longrightarrow$$

$$I_2 = 2 \cdot V_1 + 10'1 \cdot V_2 = 2(5 - 10 \cdot I_1) - 101 \cdot I_2 = 10 - 20 I_1 - 101 I_2 \longrightarrow$$

$$\left. \begin{matrix} 3 I_1 + 10 I_2 = 1 \\ 20 I_1 + 102 I_2 = 10 \end{matrix} \right\} \Rightarrow \begin{bmatrix} 3 & 10 \\ 20 & 102 \end{bmatrix} \cdot \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 1 \\ 10 \end{bmatrix}$$

$$I_1 = \frac{\begin{vmatrix} 1 & 10 \\ 10 & 102 \end{vmatrix}}{\begin{vmatrix} 3 & 10 \\ 20 & 102 \end{vmatrix}} = \frac{102 - 100}{306 - 200} = \frac{2}{106} = 18'8 \text{ mA}$$

$$I_2 = \frac{\begin{vmatrix} 3 & 1 \\ 20 & 10 \end{vmatrix}}{\begin{vmatrix} 3 & 10 \\ 20 & 102 \end{vmatrix}} = \frac{30 - 20}{106} = \frac{10}{106} = 94'3 \text{ mA}$$