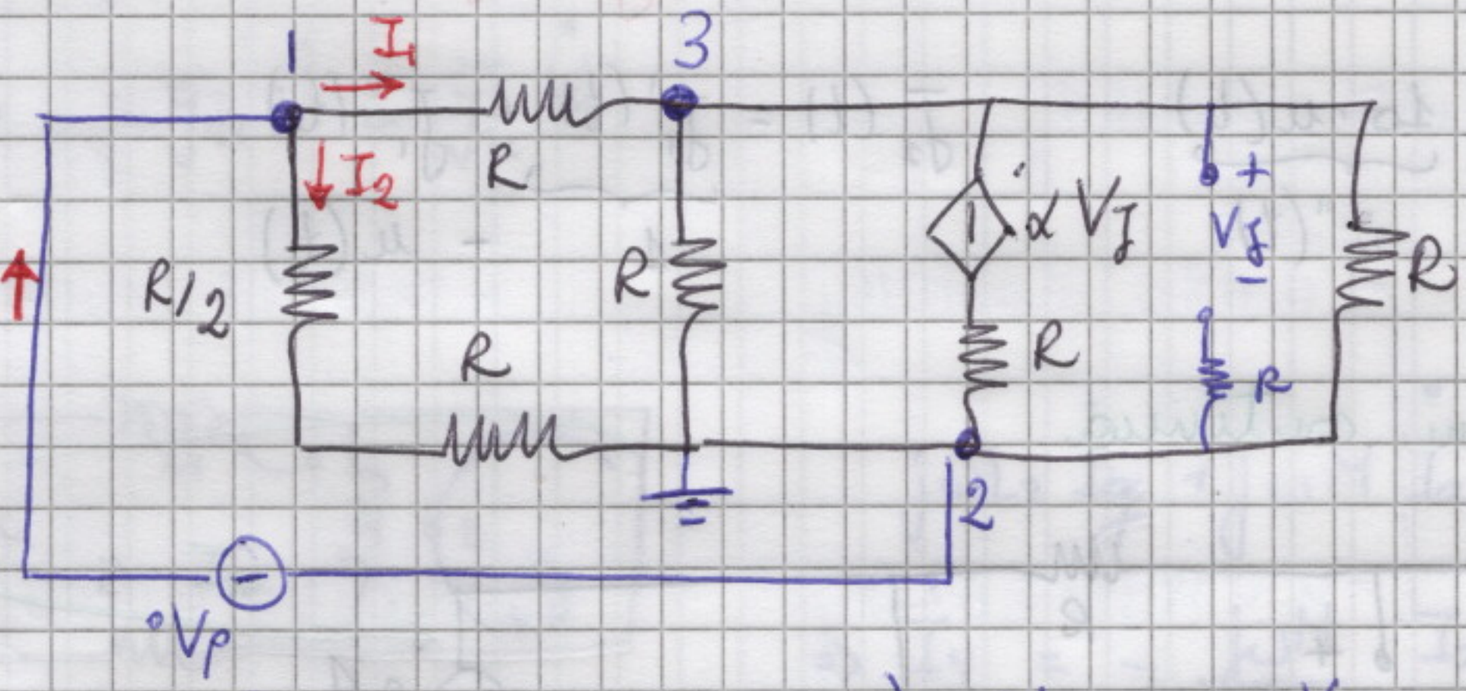
Appello 23.7.21 – ING. INFORMATICA

① R_{TH} :



$V_2 = 0$

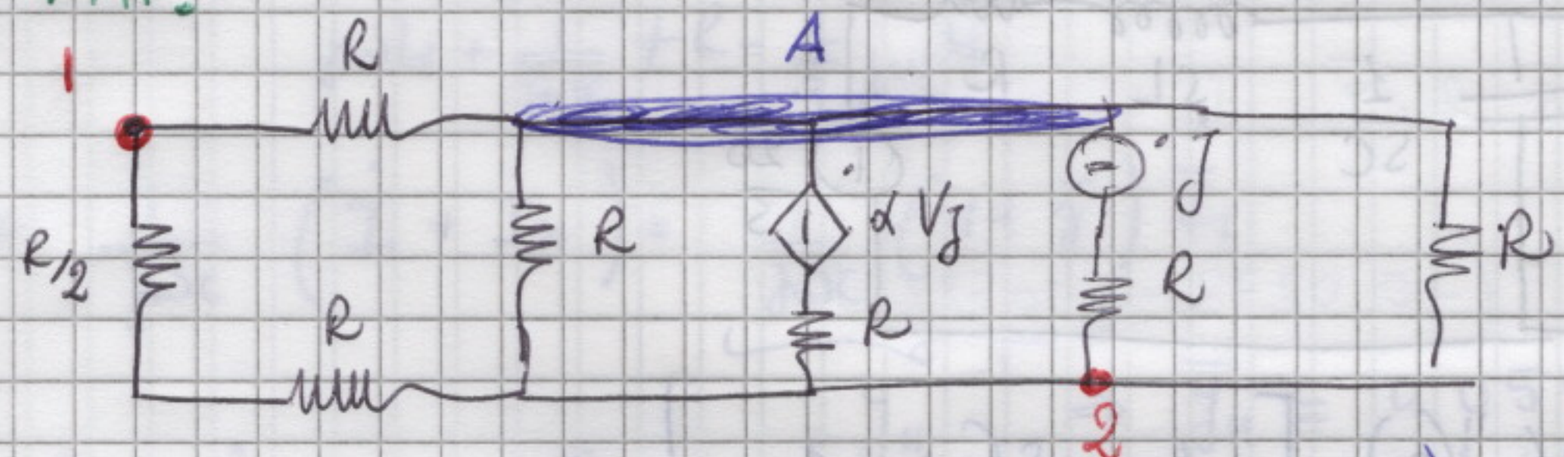
$V_1 = V_p$

$V_J = V_3 - V_2 = V_3$

3: $\frac{\alpha V_J}{R} = V_3\left(\frac{1}{R}+\frac{1}{R}+\frac{1}{R}+\frac{1}{R}\right) - \frac{V_1}{R} \Rightarrow \alpha V_3 = 4V_3 - V_p \Rightarrow V_3 = V_p$

$I_p = I_1 + I_2 = \frac{V_1 - V_3}{R} + \frac{V_p}{R + R/2} = \frac{V_p}{3/2 R} \Rightarrow \boxed{R_{TH} = \frac{3}{2}R = 15\,\Omega}$

② V_{TH}:

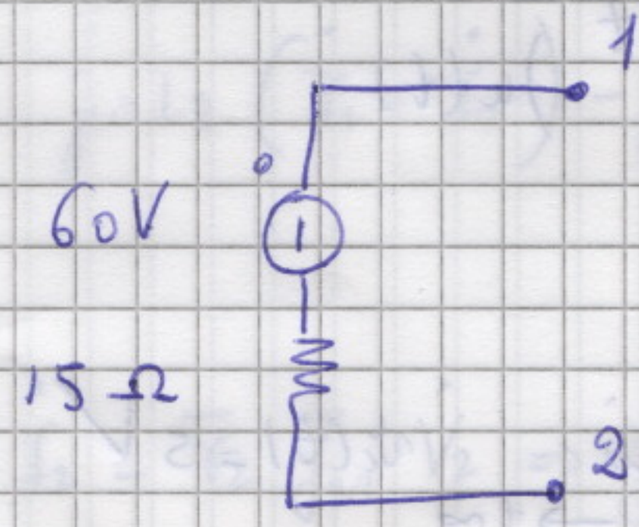


A: $J + \frac{\alpha V_J}{R} = V_A\left(\frac{1}{2R+R/2}+\frac{1}{R}+\frac{1}{R}+\frac{1}{R}\right) \Rightarrow$

$\Rightarrow 1 + \frac{\alpha V_J}{R} = V_A\left(\frac{1}{5/2 R}+\frac{3}{R}\right) \Rightarrow R + \alpha V_J = V_A(17/5)$

$V_J = V_A + RJ \Rightarrow R + \alpha(V_A + RJ) = \frac{17}{5}V_A \Rightarrow V_A = \frac{R+\alpha R}{\frac{17}{5}-\alpha} = \frac{40}{2/5} = 100\,V$

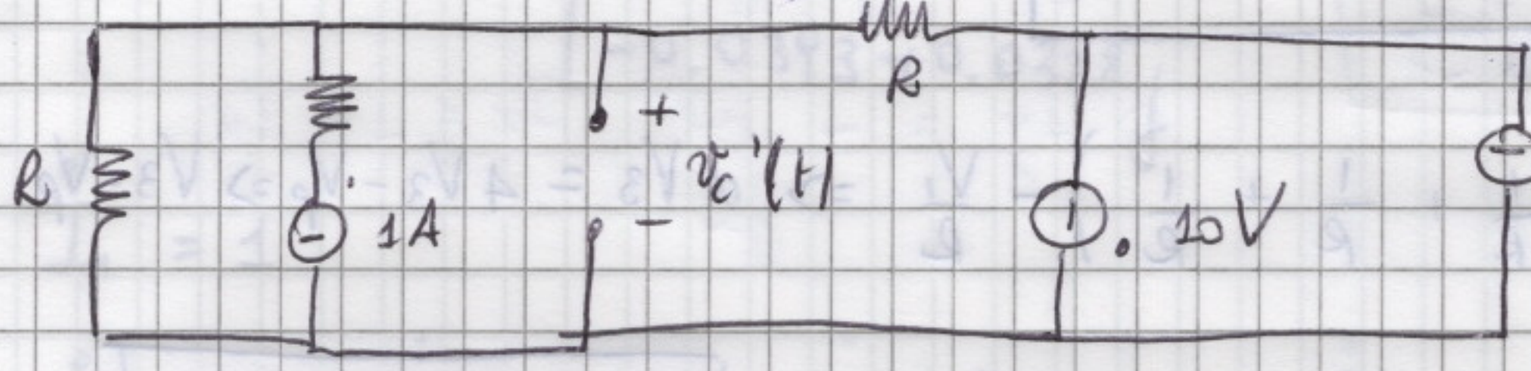
$V_{TH} = V_1 = \frac{V_A}{2R+R/2}\cdot(R+R/2) = \frac{V_A}{\frac{5}{2}R}\cdot\frac{3}{2}R = \frac{3}{5}V_A = \boxed{60\,V}$



② Risolviamo con sovrapposizione degli effetti

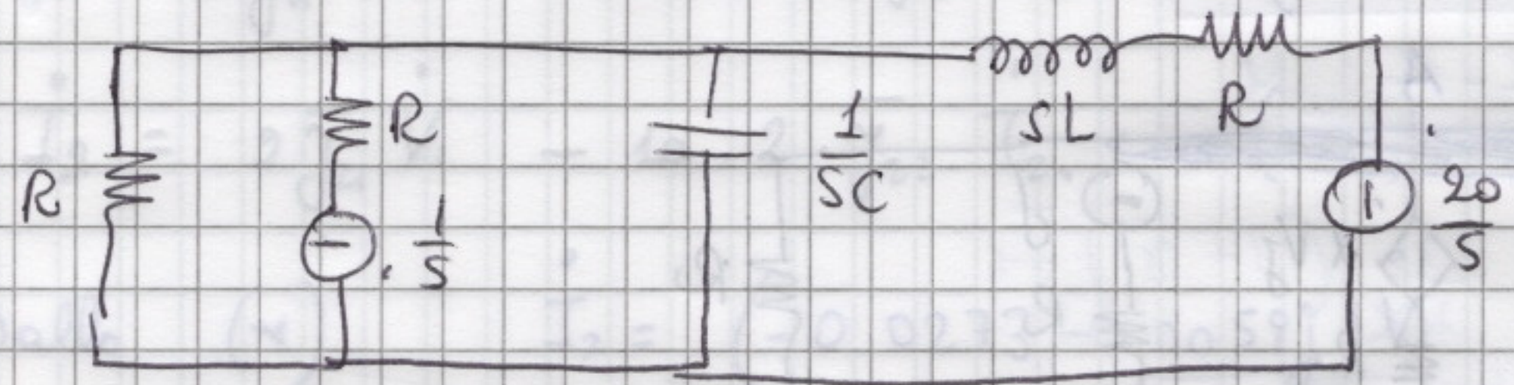
$$v(t) = \underbrace{-10}_{v'(t)} + \underbrace{10 \cdot u(t)}_{v''(t)} \qquad J_1(t) = \underbrace{J_1'(t)}_{1} + J_1''(t) - u(t)$$

① Generatori in continua



$$v_c'(t) = \frac{1}{2} \cdot R \quad - \frac{10}{2R} \cdot R + \phi = 5\,V$$

② Transitorio



$$\frac{\frac{20}{S}}{R+SL} - \frac{1}{S} = V_c''(S)\left[\frac{1}{R} + SC + \frac{1}{R+SL}\right] \rightarrow$$

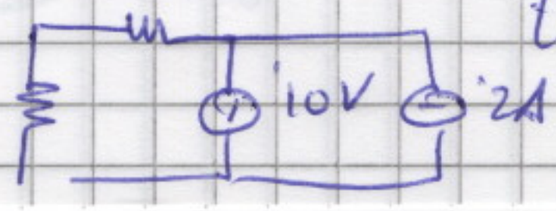
$$\Rightarrow V_c''(S) = \frac{\frac{20}{S(R+SL)} - \frac{1}{S}}{\frac{1}{R} + SC + \frac{1}{R+SL}} = \frac{20R - R(R+SL)}{S(R+SL) + S^2RC(R+SL) + SR} =$$

$$= \frac{20R - R^2 - RLS}{S\left[RLCS^2 + (L+R^2C)S + 2R\right]} = -\frac{0.02}{2 \cdot 10^{-6} S^2 + 0.041S + 40}$$

$$v_c''(t) = \left(0.5421\, e^{-19473t} - 0.5421\, e^{-1027t}\right) u(t)$$

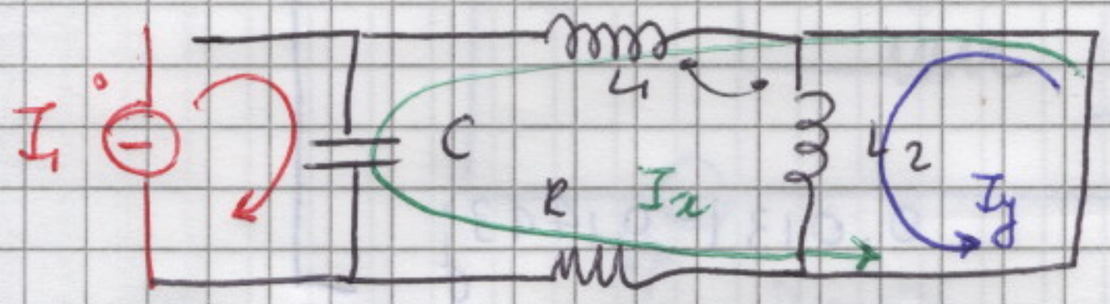
$$v_c(t) = 5 + v_c''(t)$$

$$\lim_{t \to 0^-} v_c(t) = \lim_{t \to 0^+} v_c(t) = 5\,V \qquad \lim_{t \to +\infty} v_c(t) = 5\,V$$



③
$$\begin{cases} \dot{I}_1 = \bar{y}_{11}\dot{V}_1 + \bar{y}_{12}\dot{V}_2 \\ \dot{I}_2 = \bar{y}_{21}\dot{V}_1 + \bar{y}_{22}\dot{V}_2 \end{cases}$$

① $\dot{V}_2 = \phi$



$$j\omega L_2 \dot{I}_y + j\omega M \dot{I}_x = 0 \Rightarrow$$

$$\Rightarrow \dot{I}_y = -\frac{j\omega M}{j\omega L_2}\dot{I}_x = -\frac{2}{3}\dot{I}_x$$

$$\left(j\omega L_1 + \frac{1}{j\omega C} + R\right)\dot{I}_x + \frac{1}{j\omega C}\dot{I}_1 + j\omega M\left(-\frac{2}{3}\right)\dot{I}_x = \phi \Rightarrow$$

$$\Rightarrow \dot{I}_x = -\frac{\frac{1}{j\omega C}}{j\omega L_1 + \frac{1}{j\omega C} + R - \frac{2}{3}j\omega M}\dot{I}_1 = \bar{\gamma}\dot{I}_1, \quad \bar{\gamma} = -0.1622 + 0.937j$$

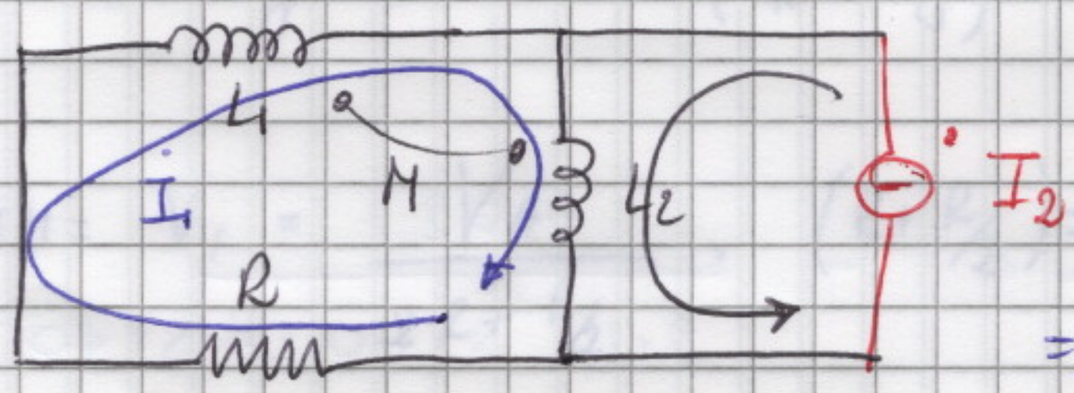
$$\dot{V}_1 = \frac{1}{j\omega C}\left(\dot{I}_1 + \dot{I}_x\right) = \frac{1}{j\omega C}\left(1 + \bar{\gamma}\right)\dot{I}_1$$

$$\bar{y}_{11}^{-1} \Rightarrow \bar{y}_{11} = 0.0590 + 0.0508j$$

$$\dot{I}_2 = \dot{I}_x + \dot{I}_y = \frac{1}{3}\dot{I}_x = \frac{1}{3}\bar{\gamma}\dot{I}_1 = \underbrace{\frac{1}{3}\bar{\gamma}\bar{y}_{11}}\dot{V}_1$$

$$\bar{y}_{21} = -0.0197 + 0.0164j$$

$\dot{V}_1 = \phi$



$$\left(j\omega L_1 + j\omega L_2 - 2j\omega M + R\right)\dot{I}_1 + \left(j\omega L_2 - j\omega M\right)\dot{I}_2 = \phi \Rightarrow$$

$$\Rightarrow \dot{I}_1 = \bar{\gamma}_2\dot{I}_2, \quad \bar{\gamma}_2 = -0.25 - 0.25j$$

$$\dot{V}_2 = j\omega L_2\left(\dot{I}_1 + \dot{I}_2\right) - j\omega M\dot{I}_1 = \underbrace{\left(j\omega L_2\bar{\gamma}_2 + j\omega L_2 - j\omega M\bar{\gamma}_2\right)}\dot{I}_2 \Rightarrow$$

$$\bar{y}_{22}^{-1} \Rightarrow y_{22} = 0.0066 - 0.0728j$$

$$\dot{I}_1 = \bar{\gamma}_2\dot{I}_2 = \bar{\gamma}_2\bar{y}_{22}\dot{V}_2 \Rightarrow \bar{y}_{12} = \bar{\gamma}_2\bar{y}_{22} = -0.0197 + 0.0164j$$

$$Y = \begin{bmatrix} 0.0590 + 0.0508j & -0.0197 + 0.0164j \\ -0.0197 + 0.0164j & 0.0066 - 0.0721j \end{bmatrix}$$

$$Y_{TOT} = 2Y = \begin{bmatrix} 0.1180 + 0.1016j & -0.0393 + 0.0328j \\ -0.0393 + 0.0328j & 0.0131 - 0.1443j \end{bmatrix}$$

$$\dot{I}_1 = 1$$

$$\dot{V}_2 = -10\,\dot{I}_2$$

$$\begin{cases} 1 = 2\bar{y}_{11}\,\dot{V}_1 - 10 \cdot 2\bar{y}_{12}\,\dot{I}_2 & (*) \\ \dot{I}_2 = 2\bar{y}_{21}\,\dot{V}_1 - 10 \cdot 2 \cdot \bar{y}_{22}\,\dot{I}_2 & (**) \end{cases}$$

Dalla $(*)$ $\quad \dot{I}_2 = (-0.0273 - 0.0059j)\,\dot{V}_1$

Dalla $(**)$ $\quad \dot{V}_1 = 4.6154 - 4.7436j \Rightarrow$

$$\Rightarrow \boxed{v_1(t) = 6.6184\sqrt{2}\,\cos(1000t - 0.7991)\,V}$$

$$\bar{S} = \dot{V}_1\,\dot{I}_1^{*} = \dot{V}_1 = \boxed{4.6154 - 4.7436j}$$