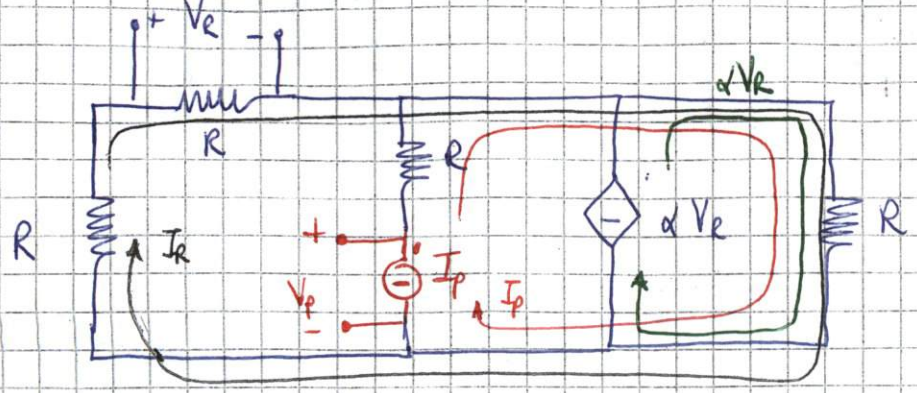
Risoluzione compito di Ingegneria Informatica 31.1.2018

① Calcolo R_{TH}

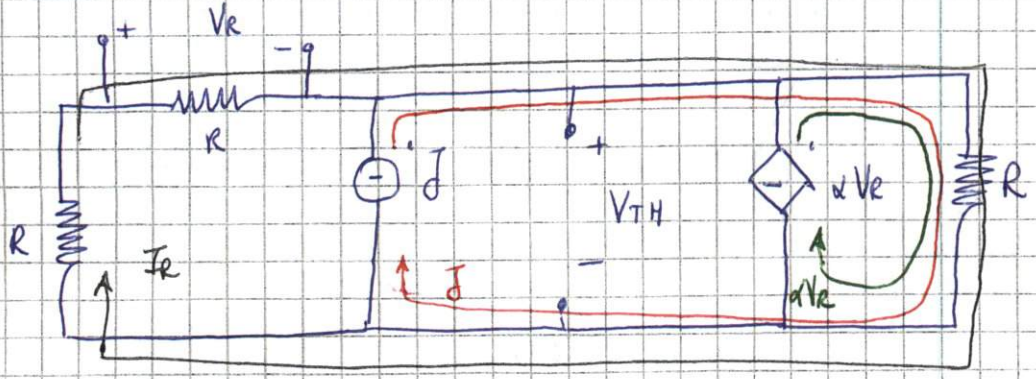


$$\begin{cases} 3RI_R + RI_p + \alpha V_R R = 0 \\ V_R = RI_R \end{cases} \Rightarrow 3RI_R + RI_p + \alpha R^2 I_R = 0 \Rightarrow$$

$$\Rightarrow I_R = -\frac{RI_p}{3R + \alpha R^2} = -\frac{1}{5} I_p$$

$$V_p = RI_p - 2R \cdot I_R = RI_p + \frac{2}{5} RI_p = \frac{7}{5} RI_p \Rightarrow \boxed{R_{TH} = \frac{7}{5} R = 14\,\Omega}$$

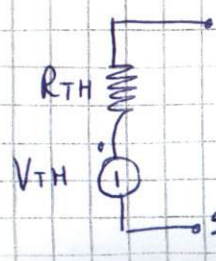
Calcolo V_{TH}



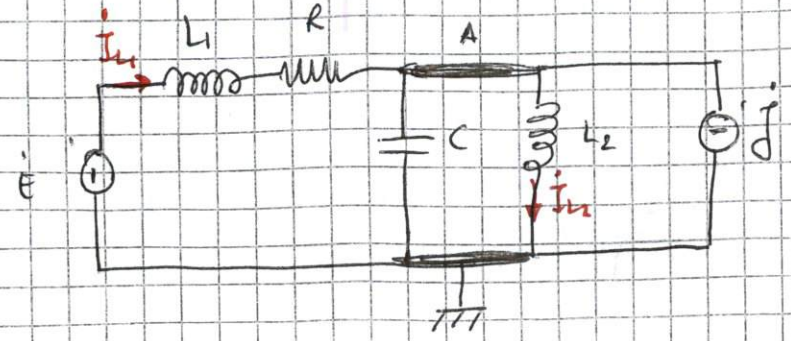
$$3RI_R + \alpha V_R R + JR = 0 \Rightarrow 3RI_R + \alpha R^2 I_R + JR = 0 \Rightarrow$$

$$\Rightarrow I_R = -\frac{J}{3 + \alpha R} = -\frac{1}{5} J = -0.4\,A$$

$$V_{TH} = -2RI_R = 0.8R = \boxed{8\,V = V_{TH}}$$



(2)



$\dot{E} = 30$

$\dot{J} = 1$

$\dot{V}_A = ?$

$$\dot{J} + \frac{\dot{E}}{j\omega L_1 + R} = \left(j\omega C + \frac{1}{j\omega L_2} + \frac{1}{R + j\omega L_1} \right) \dot{V}_A \Rightarrow$$

$$\Rightarrow \dot{V}_A = \frac{\dot{J} + \frac{\dot{E}}{j\omega L_1 + R}}{j\omega C + \frac{1}{j\omega L_2} + \frac{1}{R + j\omega L_1}} = 50 - 30j$$

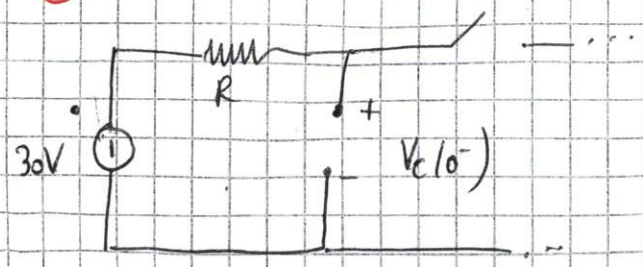
$$\dot{I}_{L_2} = \frac{\dot{V}_A}{j\omega L_2} = -1.5 - 2.5j = 2.9155 \cdot e^{-j\,2.1112}$$

$$\boxed{W_{L_2} = \frac{1}{2} L_2 I_{L_2}^2 = 0.085\ J}$$

$$\dot{I}_{L_1} = \frac{\dot{E} - \dot{V}_A}{R + j\omega L_1} = 0.5 + 2.5j = 2.5495\, e^{j\,1.3734}$$

$$\boxed{P_A = E \cdot I_{L_1} = 76.4853\ VA}$$

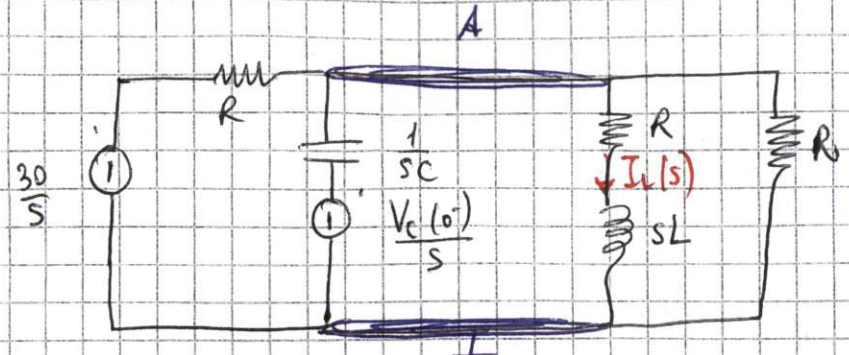
(3) $t<0$



$V_c(0^-) = 30\,V$

$i(t) = 0$

$t>0$



Risolviamo con metodo delle tensioni di nodo

$$\frac{30}{sR} + CV_c(0^-) = V_A(s)\left[\frac{1}{R} + sC + \frac{1}{R} + \frac{1}{R+sL}\right] \Rightarrow$$

$$\Rightarrow \frac{30}{sR} + 30C = V_A(s)\left[\frac{2}{R} + sC + \frac{1}{R+sL}\right] \Rightarrow$$

$$\Rightarrow V_A(s) = \frac{\frac{30}{sR} + 30C}{\frac{2}{R} + sC + \frac{1}{R+sL}} = \frac{30(R+sL) + 30CsR(R+sL)}{2s(R+sL) + s^2RC(R+sL) + 5R}$$

$$I_L(s) = \frac{V_A(s)}{R+sL} = \frac{30 + 30RCs}{2sR + 2Ls^2 + s^2R^2C + s^3RLC + sR} = \frac{30 + 30RCs}{s\left[RLCs^2 + (2L+R^2C)s + 3R\right]} =$$

$$= \frac{0.006\,s + 30}{s\left(2\cdot10^{-6}s^2 + 0.024\,s + 60\right)}$$

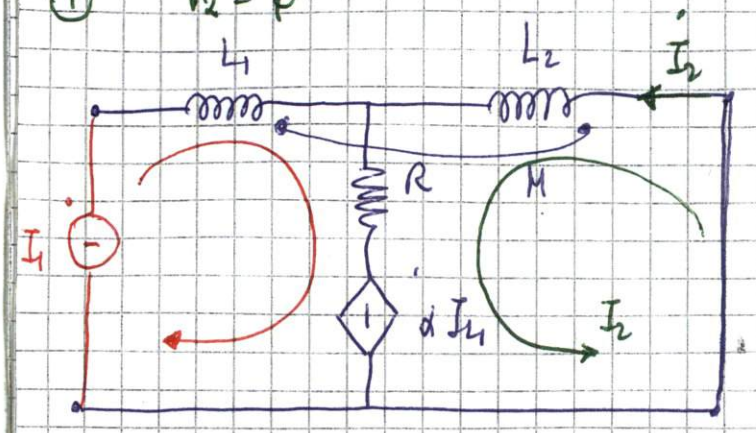
$$\Rightarrow \boxed{i_L(t) = \left(-0.25\cdot e^{-8449.5t} - 0.25\cdot e^{-3550.5t} + 0.5\right)u(t)}$$

$$\lim_{t\to 0^-} i_L(t) = \lim_{t\to 0^+} i_L(t) = 0 \quad \text{ok!}$$

$$\lim_{t\to +\infty} i_L(t) = 0.5\,A = \frac{\frac{E}{R}}{3} = \frac{E}{3R} = \frac{30}{60} = 0.5A \quad \text{ok!}$$

④ $\begin{cases} \dot{V}_1 = \bar{h}_{11}\dot{I}_1 + h_{12}\dot{V}_2 \\ \dot{I}_2 = \bar{h}_{21}\dot{I}_1 + \bar{h}_{22}\dot{V}_2 \end{cases}$

① $\dot{V}_2 = \phi$



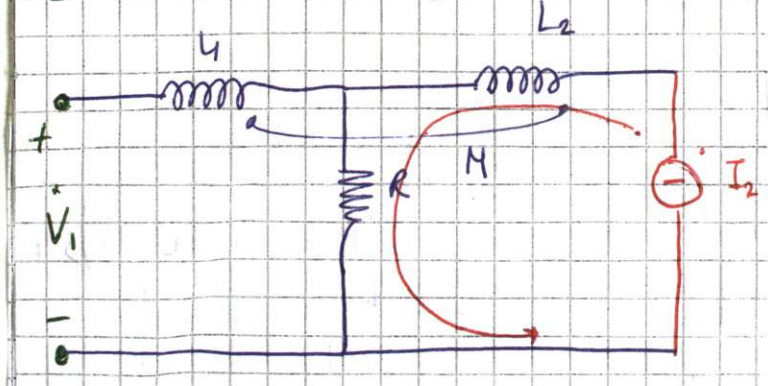
$$(R+j\omega L_2)\dot{I}_2 + (R-j\omega M)\dot{I}_1 + \alpha\dot{I}_1 = \phi \Rightarrow$$

$$\Rightarrow \dot{I}_2 = \frac{-\alpha R + j\omega M}{R+j\omega L_2}\dot{I}_1 = \underbrace{(-0.216 + 1.088j)}_{\bar{h}_{21}}\dot{I}_1$$

$$\dot{V}_1 = j\omega L_1 \dot{I}_1 - j\omega M \dot{I}_2 - j\omega L_2 \dot{I}_2 + j\omega M \dot{I}_1 = (j\omega L_1 + j\omega M)\dot{I}_1 - (j\omega M + j\omega L_2)\bar{h}_{21}$$

$$= \underbrace{(34.816 + 28.912j)}_{\bar{h}_{11}}\dot{I}_1$$

② $\dot{I}_1 = \phi$



$$\dot{V}_1 = -j\omega M \dot{I}_2 + R\dot{I}_2 = (15 - 12j)\dot{I}_2$$

$$\dot{V}_2 = (j\omega L_2 + R)\dot{I}_2 = \underbrace{(15+20j)}_{(h_{12})^{-1}}\dot{I}_2 \Rightarrow h_{12} = \frac{1}{15+20j} = 0.024 - 0.032j$$

$$\dot{V}_1 = (15-12j)\dot{I}_2 = \frac{15-12j}{15+20j}\dot{V}_2 = \underbrace{-0.024 - 0.768j}_{h_{12}}$$

$$h = \begin{bmatrix} 34.816 + 28.912j & -0.024-0 \\ -0.216 + 1.088j & 0.024 - 0.032 \end{bmatrix}$$