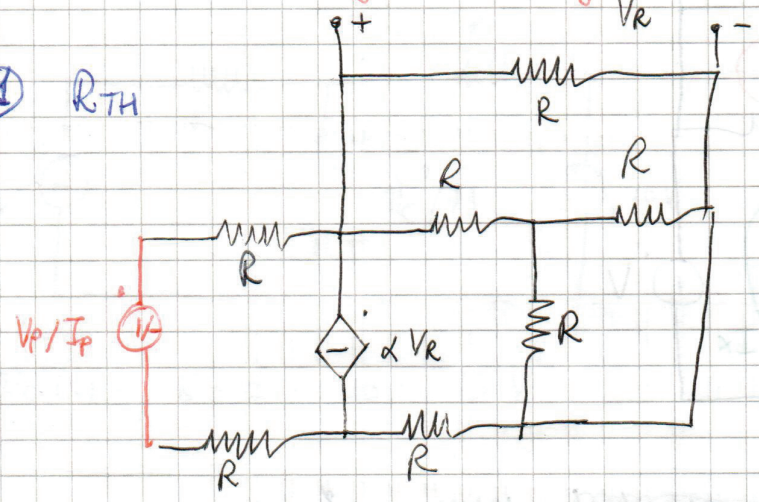
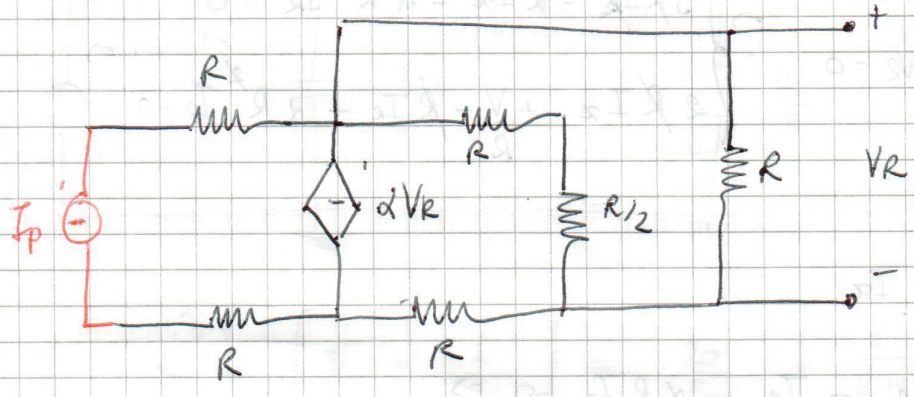
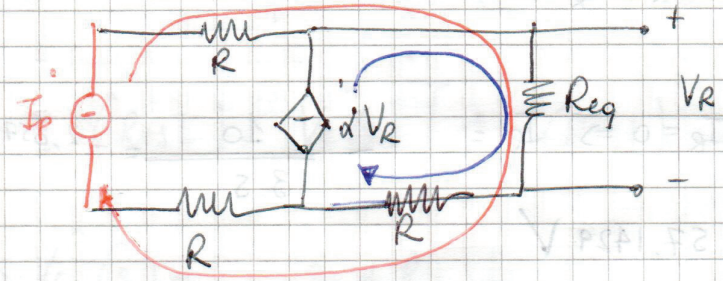
# Soluzione compito 22 Luglio 2020

① $R_{TH}$



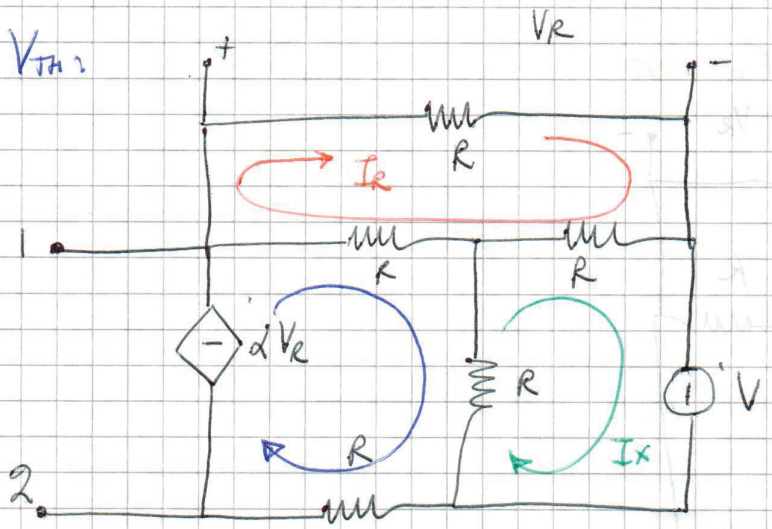

$$R_{eq} = \frac{3}{2}R \,//\, R = \frac{\frac{3}{2}R^2}{\frac{5}{2}R} = \frac{3}{5}R = 6\,\Omega$$

$$V_R = (\alpha V_R + I_P)\cdot R_{eq} \Rightarrow V_R(1 - \alpha R_{eq}) = R_{eq} I_P \Rightarrow$$

$$\Rightarrow V_R = \frac{R_{eq}}{1-\alpha R_{eq}} I_P = \frac{6}{1-\frac{1}{20}\cdot 6} I_P = \frac{6}{\frac{7}{10}} I_P = \frac{60}{7} I_P$$

$$R_{TH} = \frac{V_P}{I_P} = \frac{R I_P + V_R + R I_P + R I_P + R_q V_R}{I_P} = \frac{30 + \frac{60}{7} + \frac{30}{7}}{I_P} I_P = \frac{300}{7} = 42.8571\,\Omega$$

$V_{TH}$ ?



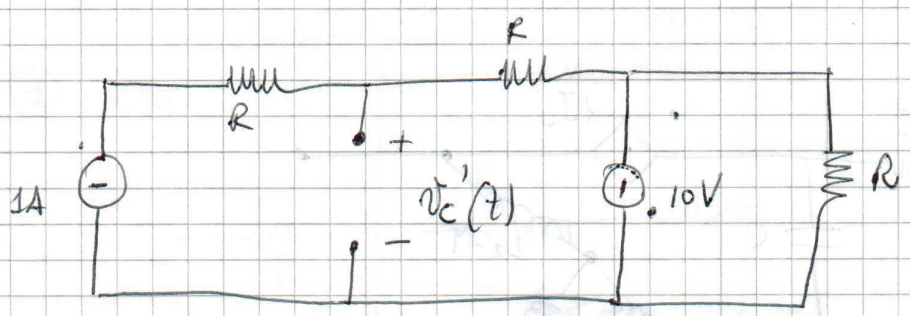

$$\begin{cases} 3RI_R - RI_x - R\alpha V_R = 0 \\ 2RI_x + V - RI_R - R\alpha V_R = 0 \\ V_R = RI_R \end{cases} \Rightarrow \begin{cases} 3RI_R - RI_x - \alpha R^2 I_R = 0 \\ 2RI_x + \frac{V}{R} - RI_R - \alpha R^2 I_R = 0 \end{cases} \Rightarrow$$

$$\Rightarrow \begin{cases} 3I_R - \alpha R I_R = I_x \\ 6I_R + \frac{V}{R} - 2\alpha R I_R - I_R - \alpha R I_R = 0 \Rightarrow \end{cases}$$

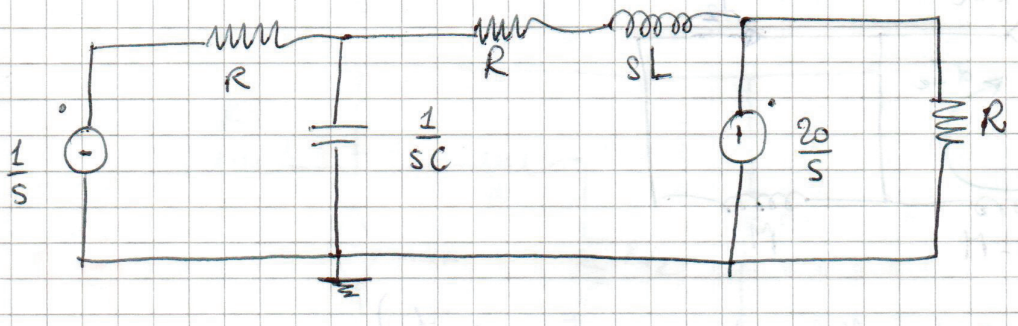
$$\Rightarrow 6I_R + 10 - I_R - I_R - 0.5 I_R = 0 \Rightarrow I_R = -\frac{10}{3.5} = -2.8571\ A$$

$$V_{TH} = RI_R + V + R \cdot \alpha \cdot R I_R = 57.1429\ V$$

② Risolviamo con sovr. effetti




$$v_c'(t) = R \cdot 1 - 10 = 15\ V$$




$$\frac{1}{s} = V_c''(s) \cdot \left[ sC + \frac{1}{R+sL} \right] - \frac{20}{s} \cdot \left[ \frac{1}{R+sL} \right] \Rightarrow$$

$$\Rightarrow 1\ (R+sL) = V_c''(s) \left[ s^2 C\ (R+sL) + 1 \right] - 20 \Rightarrow$$

$$\Rightarrow V_c''(s) = \frac{20 + R + sL}{s\left(s^2 \cdot LC + s \cdot RC + 1\right)} = \frac{0.01s + 45}{s\left(10^{-6} s^2 + 0.0025 s + 1\right)}$$

$$v_c''(t) = \left(8.33\, e^{-2000t} - 53.33\, e^{-500t} + 45\right) u(t)$$

$$v_c(t) = 15 + \left(8.33\, e^{-2000t} - 53.33\, e^{-500t} + 45\right) u(t)$$

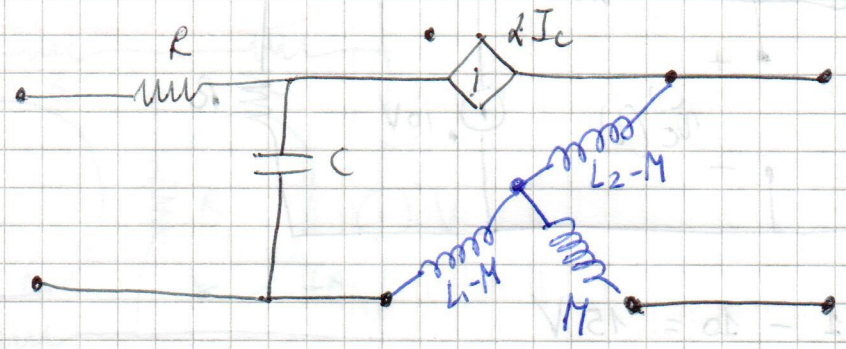
$$v_c(0^-) = v_c(0^+) = 15V \qquad v_c(+\infty) = 60\ V$$

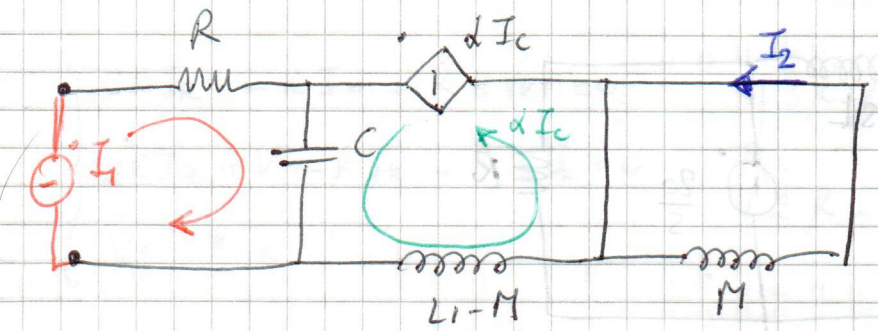
$$v_c(+\infty) = R \cdot I(+\infty) + E(+\infty) = 25 \cdot 2 + 10 = 60\ V \quad \text{ok!}$$

③ $\dot{V}_1 = \bar{h}_{11}\dot{I}_1 + \bar{h}_{12}\dot{V}_2$

$\dot{I}_2 = \bar{h}_{21}\dot{I}_1 + \bar{h}_{22}\dot{V}_2$

① $\dot{V}_2 = 0$



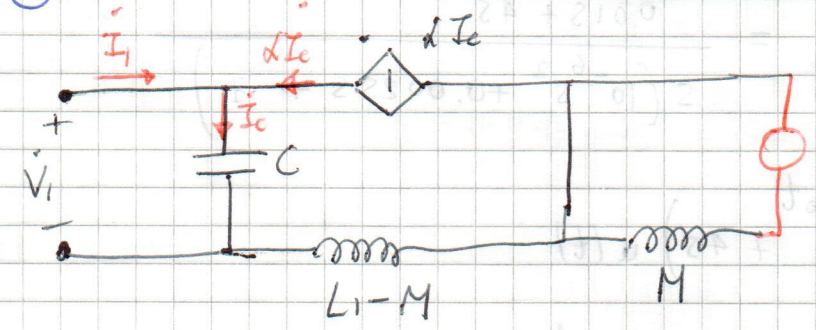




$\dot{I}_2 = \phi$ (pues M en paralelo a un corto circuito)

$\dot{I}_c = \dot{I}_1 + \alpha\dot{I}_c \Rightarrow (1-\alpha)\dot{I}_c = \dot{I}_1 \Rightarrow \dot{I}_c = \frac{1}{1-\alpha}\dot{I}_1 \Rightarrow \boxed{h_{21} = 0}$

$\dot{V}_1 = R\dot{I}_1 + \frac{1}{j\omega C}\dot{I}_c = \underbrace{\left(R + \frac{1}{j\omega C}\cdot\frac{1}{1-\alpha}\right)}_{\bar{h}_{11}}\dot{I}_1 = \boxed{10 - 11.11j}$

② $\dot{I}_1 = 0$




$\dot{I}_c = \alpha\dot{I}_c \Rightarrow \dot{I}_c = \phi \Rightarrow \dot{V}_1 = \frac{1}{j\omega C}\cdot\dot{I}_c = \phi$

$\dot{V}_2 = j\omega M\cdot\dot{I}_2 \Rightarrow \bar{h}_{22} = \frac{1}{j\omega M} = -0.0667j$

$$h = \begin{bmatrix} 10 - 11.11j & 0 \\ 0 & -0.0667j \end{bmatrix}$$

$\dot{I}_1 = \frac{\dot{V}_1}{\bar{h}_{11}} = 2.2376 + 2.4862j$

$\dot{I}_1 = \dot{I}_c - \alpha\dot{I}_c = 0.9\dot{I}_c \Rightarrow \dot{I}_c = 2.4862 + 2.7624j$

$\dot{I}_c = 3.7165\angle 0.838 \Rightarrow \boxed{i_c(t) = 3.7165\sqrt{2}\,\text{sen}(1000t + 0.838)}$