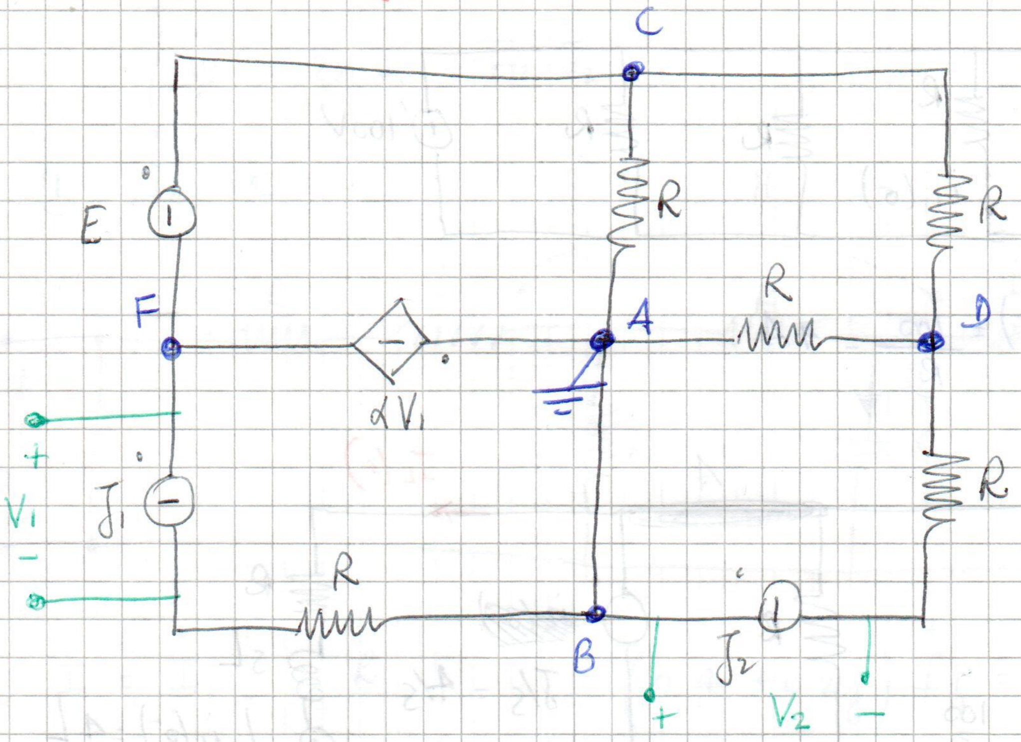
Risoluzione congiunto 16.9.2020



$P = J_1 V_1 + J_2 V_2$

$V_A = V_B = 0$

$V_F = -\alpha V_1$

$V_C = -\alpha V_1 + E$

$V_D = ?$

$$\begin{cases} D: \; -J_2 = V_D\left(\frac{1}{R} + \frac{1}{R}\right) - V_C \cdot \frac{1}{R} \\ V_{FB} = V_F = V_1 - R J_1 \Rightarrow \end{cases}$$

$\Rightarrow V_1 = V_F + R J_1 = -\alpha V_1 + R J_1 \Rightarrow$

$\Rightarrow V_1 (1+\alpha) = R J_1 \Rightarrow V_1 = \frac{R J_1}{1+\alpha} = \boxed{2.5\,V}$

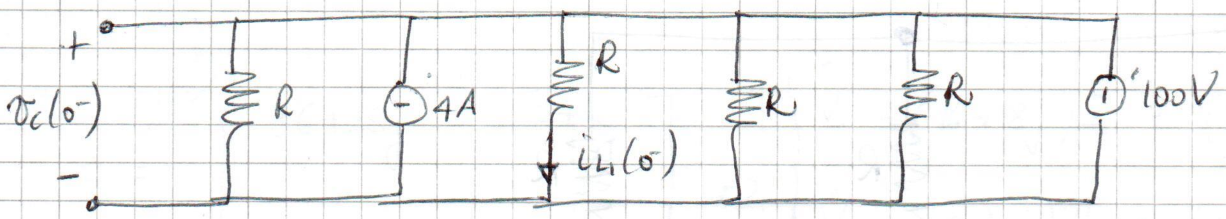
$D: \; -2 = V_D\left(\frac{2}{R}\right) - \frac{1}{R}\left(-\alpha V_1 + E\right) \Rightarrow$

$\Rightarrow -2R = 2V_D + \alpha \cdot V_1 - E \Rightarrow 80 - 7.5 = 2V_D \Rightarrow V_D = 36.25\,V$

$V_2 = V_{BD} + R J_2 = -36.25 + 20 = \boxed{-16.25}$

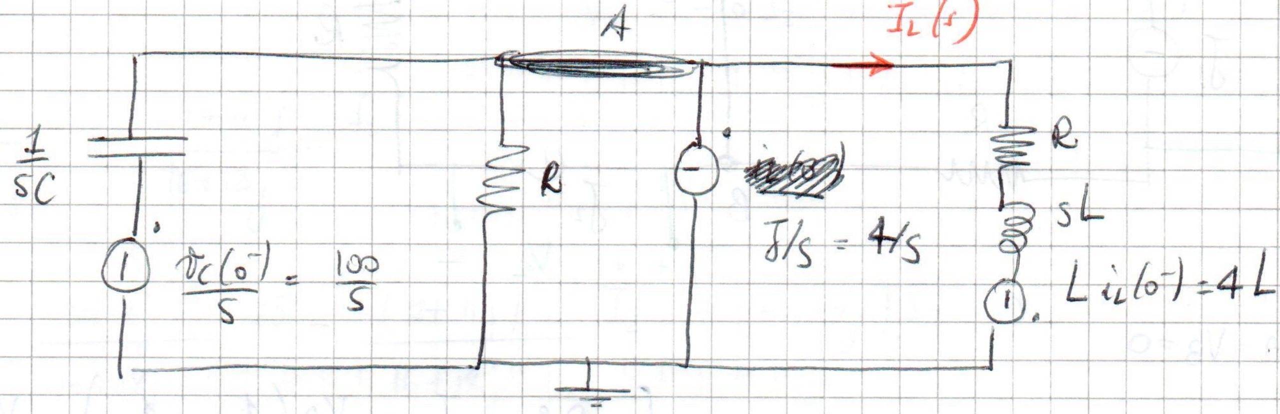
$P = J_1 V_1 + J_2 V_2 = 2.5 - 32.5 = \boxed{-30\,W}$

(2) $\boxed{t<0}$



$v_C(0^-) = 100\,V \qquad i_L(0^-) = \frac{100}{R} = 4A$

$\boxed{t>0}$



$$\frac{v_C(0^-)}{\cancel{s}}\,\cancel{s}C + \frac{4}{s} - \frac{4L}{R+sL} = V_A(s)\left[sC + \frac{1}{R} + \frac{1}{R+sL}\right] \Rightarrow$$

$$\Rightarrow V_A(s) = \frac{C v_C(0^-) + \frac{4}{s} - \frac{4L}{R+sL}}{sC + \frac{1}{R} + \frac{1}{R+sL}} = \frac{100RCs(R+sL) + 4R(R+sL) - 4RLs}{s^2RC(R+sL) + s(R+sL) + sR}$$

$$I_L(s) = \frac{V_A(s) + L\,i_L(0^-)}{R+sL} = \frac{100RCs\cancel{(R+sL)} + 4R\cancel{(R+sL)} - \cancel{4RLs} + 4RLCs^2\cancel{(R+sL)} + 4Ls\cancel{(R+sL)} + \cancel{4RLs}}{(s^2RC(R+sL) + s(R+sL) + sR)\cancel{(R+sL)}} =$$

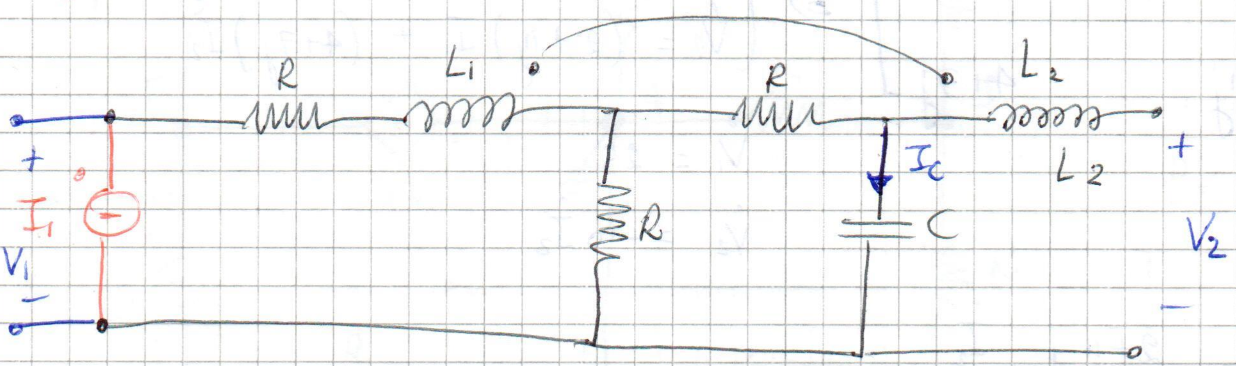
$$= \frac{100RCs + 4R + 4RLCs^2 + 4Ls}{s\left[RLCs^2 + (R^2C+L)s + 2R\right]} = \frac{0.0001s^2 + 0.29s + 100}{s\left[2.5\cdot 10^{-5}s^2 + 0.0725s + 50\right]}$$

$$\boxed{i_L(t) = \begin{cases} 4A, & t<0 \\ -3.529e^{-1770.2t} + 5.529\cdot e^{-1129.8t} + 2, & t\geq 0 \end{cases}}$$

$i_L(0^-) = i_L(0^+) = 4A \qquad i_L(+\infty) = 2A$, (ok, partitore corrente)

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

① $\dot{I}_2 = 0$

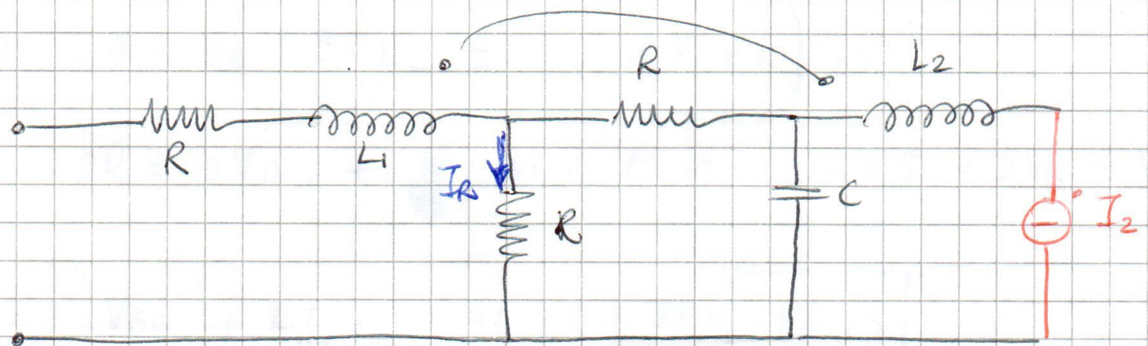


$$\dot{I}_c = \dot{I}_1 \cdot \frac{R}{2R + \frac{1}{j\omega C}} = (0.4 + 0.2j)\,\dot{I}_1 = \overline{\gamma}\,\dot{I}_1$$

$$\dot{V}_2 = \dot{I}_1\, j\omega M + \frac{1}{j\omega C}\,\dot{I}_c = \underbrace{\left[j\omega M + \frac{1}{j\omega C}\,\overline{\gamma} \right]}_{\overline{z}_{21} = \boxed{2 + 11j}} \dot{I}_1$$

$$\dot{V}_1 = (R + j\omega L_1)\,\dot{I}_1 + R\,(\dot{I}_1 - \gamma\,\dot{I}_1) \Rightarrow \overline{z}_{11} = R + j\omega L_1 + R - \overline{\gamma} R = \boxed{16 + 18j}$$

② $\dot{I}_1 = 0$



$$\dot{I}_R = \dot{I}_2 \cdot \frac{\frac{1}{j\omega C}}{2R + \frac{1}{j\omega C}} = (0.2 - 0.4j)\,\dot{I}_2 = \overline{\gamma}\,\dot{I}_2$$

$$\dot{V}_1 = j\omega M\,\dot{I}_2 + R\,\dot{I}_R = \underbrace{\left(j\omega M + \overline{\cancel{\gamma}}\,R \right)}\,\dot{I}_2$$

$$\overline{z}_{12} = 2 + 11j = \overline{z}_{21} \quad \text{ok!}$$

$$\dot{V}_2 = j\omega L_2 \dot{I}_2 + 2R\bar{\gamma}\dot{I}_2 \Rightarrow \overline{Z_{22}} = j\omega L_2 + 2\bar{\gamma}R = 4+7j$$

$$\bar{Z} = \begin{bmatrix} 16+18j & 2+11j \\ 2+11j & 4+7j \end{bmatrix} \Rightarrow \begin{cases} \dot{V}_1 = (16+18j)\dot{I}_1 + (2+11j)\dot{I}_2 \\ \dot{V}_2 = (2+11j)\dot{I}_1 + (4+7j)\dot{I}_2 \end{cases}$$

$$\dot{V}_1 = 25$$

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

$$\dot{I}_1 = \frac{25}{16+18j} - \frac{2+11j}{16+18j}\dot{I}_2$$

$$-10\dot{I}_2 = \frac{2+11j}{16+18j}25 - \frac{(2+11j)^2}{16+18j}\dot{I}_2 + (4+7j)\dot{I}_2 \Rightarrow$$

$$\Rightarrow \dot{I}_2 = 0.725\, e^{-2.7298j}$$

$$\dot{I}_R = -\dot{I}_2 = \dot{I}_2\, e^{j\pi} = 0.725\, e^{j0.412}$$

$$P = 10\, I_R^2 = 5.2565\ W$$

$$I_R(t) = 0.725\sqrt{2}\ \mathrm{sen}(1000t + 0.412)\,A$$