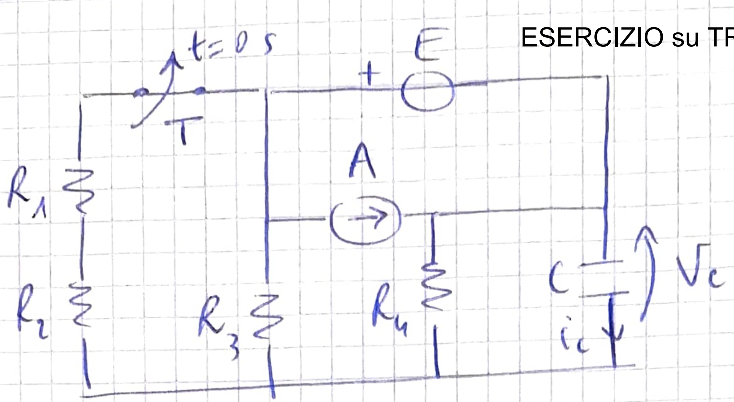
1

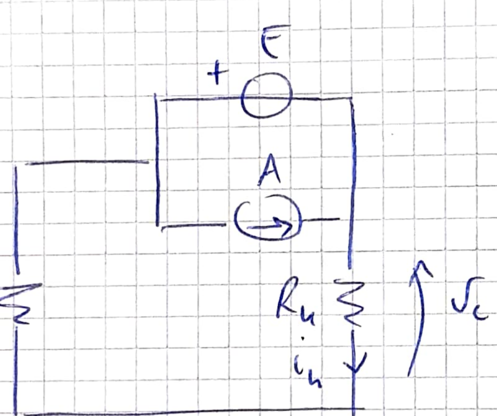


Dati: $R_1 = R_2 = 1\,\Omega$, $R_3 = 2\,\Omega$, $R_4 = 1\,\Omega$, $C_1 = 1\,F$
$E = 2\,V$, $A = 3\,A$

$t = 0^-$ ⇒ regime T chiuso

Trova: $i_c(t>0)$ & $v_c(t>0)$

$\boxed{t = 0^-}$



$R_e = (R_1 + R_2) // R_3 = 1\,\Omega$

$i_c(0^-) = 0\ A$

Sovrapposizione effetti:

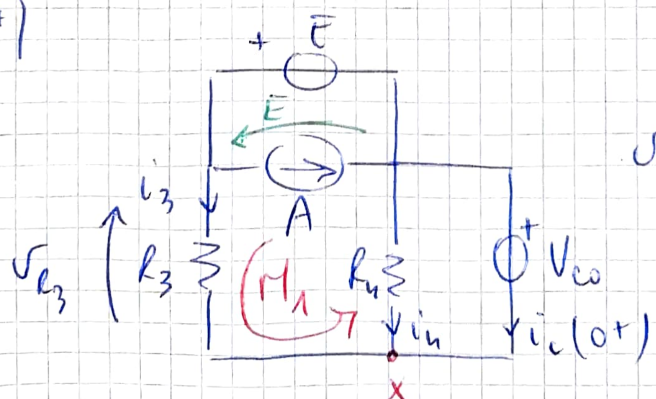
$E = 0 \Rightarrow i_4' = 0\ A$ (R_e & R_4 cortocircuitate)

$A = 0 \Rightarrow i_4'' = -\dfrac{E}{R_e + R_4} = -1\ A$

$\Big\}\ i_4 = -1\,A$

$\Rightarrow v_c(0^-) = i_4 R_4 = -1\ V$

$\boxed{t = 0^+}$



LKT (M_1):

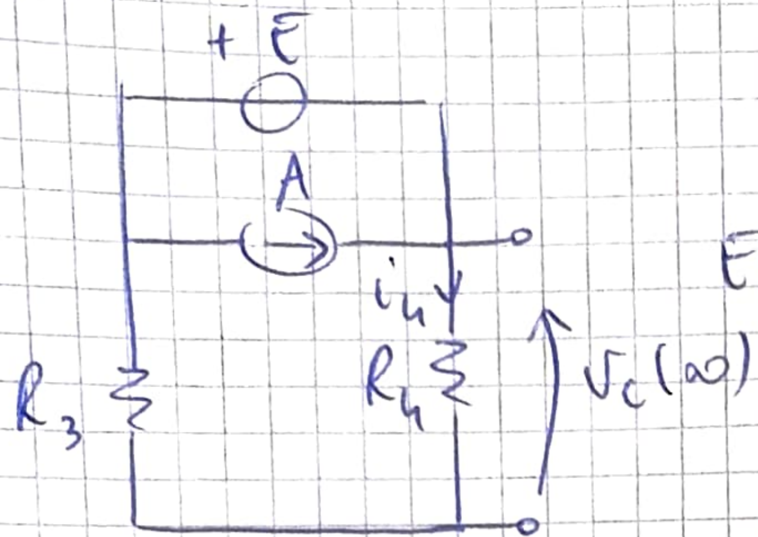
$v_{R_3} = E + V_{c0} = 2 - 1 = 1\ V$

Ohm: $i_3 = \dfrac{v_{R_3}}{R_3} = \dfrac{1}{2}\ A$

$i_4 = \dfrac{V_{c0}}{R_4} = -1\ A$

LKC (x): $i_c(0^+) = -i_3 - i_4 = \dfrac{1}{2}\ A$; $R_{eq} = R_3 // R_4 = \dfrac{2}{3}\,\Omega \Rightarrow \tau = R_{eq} C = 2/3\ s$

$\boxed{t = \infty}$



$i_c(\infty) = 0$ A

Sovrapposizione effetti:

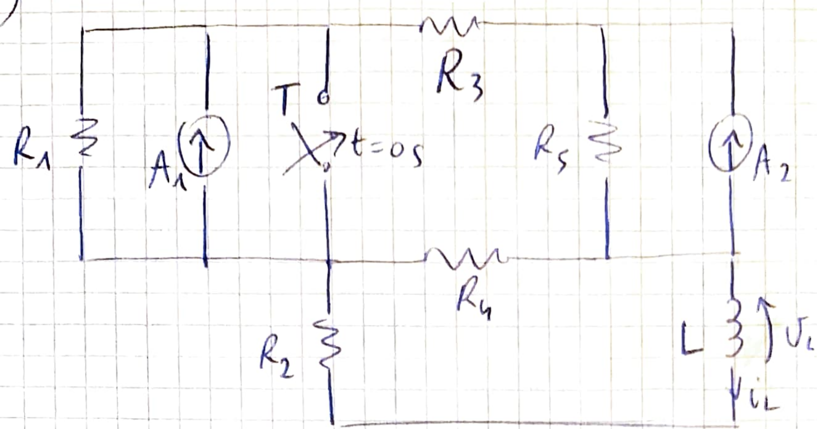
$E = 0 \Rightarrow i_4' = 0$ A ; $A = 0 \Rightarrow i_4'' = -\dfrac{E}{R_3 + R_4} = -\dfrac{2}{3}$ A

$\Rightarrow i_4 = -\dfrac{2}{3}$ A

$\Rightarrow v_c(\infty) = i_4 R_4 = -\dfrac{2}{3}$ V

$$\Rightarrow \begin{cases} v_c(t) = [v_c(0) - v_c(\infty)] e^{-t/\tau} + v_c(\infty) = \left[-1 + \dfrac{2}{3}\right] e^{-\frac{3}{2}t} - \dfrac{2}{3} \text{ V} \\ i_c(t) = [i_c(0) - i_c(\infty)] e^{-t/\tau} + i_c(\infty) = \dfrac{1}{2} e^{-3/2\, t} \text{ A} \end{cases}$$

② ESERCIZIO SU TRANSITORI – ANDAMENTO NEL TEMPO

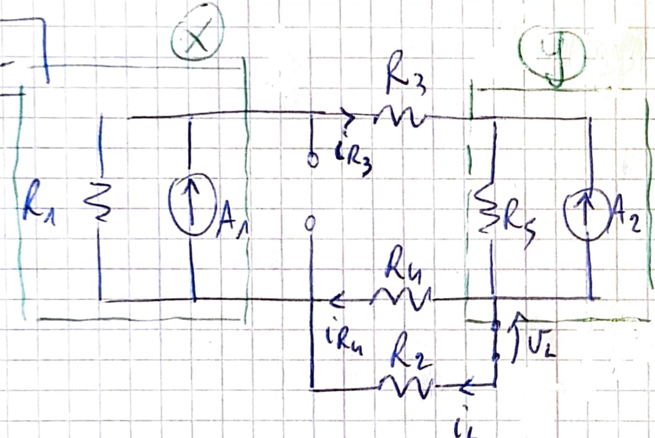


Dati: $R_1 = R_2 = R_5 = 3\,\Omega$, $R_3 = 1\,\Omega$, $R_4 = 2\,\Omega$, $L = 3\,H$
$A_1 = 3\,A$, $A_2 = 3\,A$

$t = 0^-$: regime con T aperto

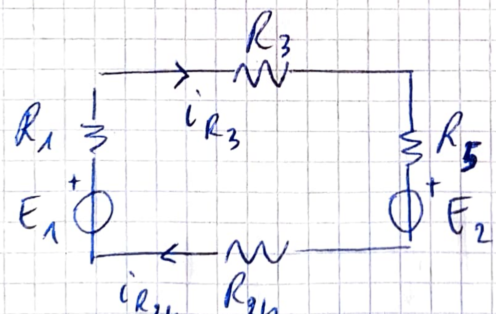
Trova: $i_L(t)$ & $v_L(t)$ per $t > 0\,s$

$|t = 0^-|$



X ≡ Y dato che $\begin{cases} R_1 = R_5 \\ A_1 = A_2 \end{cases}$

trasformo i due bipoli di Norton in bipoli di Thevenin



$\boxed{E_1 = E_2}$

Dalla LKT, applico legge di Ohm: $i_{R_3} = \dfrac{E_1 - E_2}{R_1 + R_3 + R_5 + R_{24}} = 0\,A$

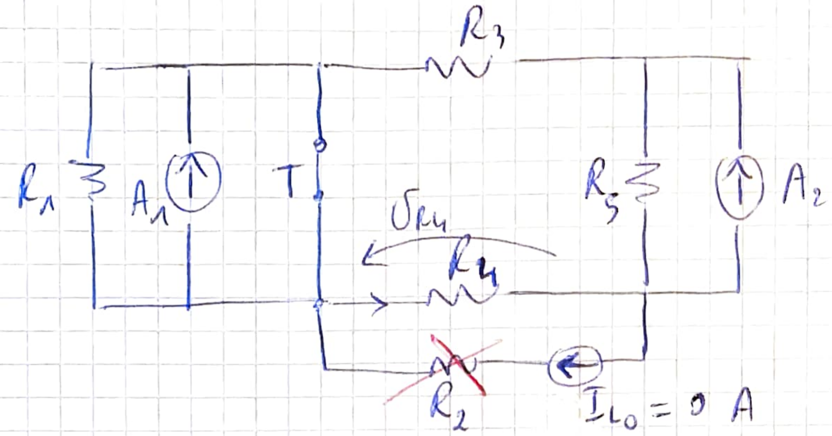
$= i_{R_{24}}$

⇒ Partitore di corrente:

$i_L(0^-) = i_{R_{24}} \cdot \dfrac{R_4}{R_4 + R_2} = 0\,A$

$v_L(0^-) = 0\,V$

$\boxed{t = 0^+}$

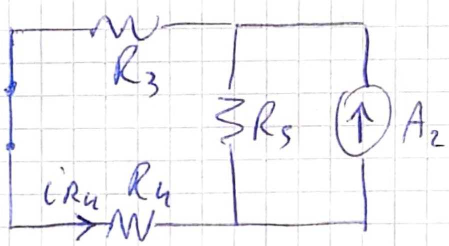


$I_{L_0} = 0$ A

$v_L(0^+) = -v_{R_4}$

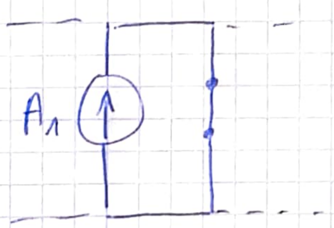
Sovrapposizione effetti:

$A_1 = 0$



$$i_{R_4}' = A_2 \frac{R_5}{R_3 + R_4 + R_5} = \frac{3}{2} \text{ A}$$

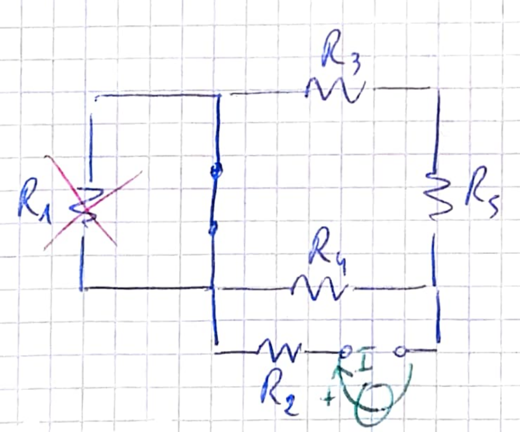
$A_2 = 0$



$i_{R_4}'' = 0$ A

$\Rightarrow i_{R_4} = \frac{3}{2}$ A $\Rightarrow v_{R_4} = i_{R_4} \cdot R_4 = 3$ V $\Rightarrow v_L(0^+) = -3$ V

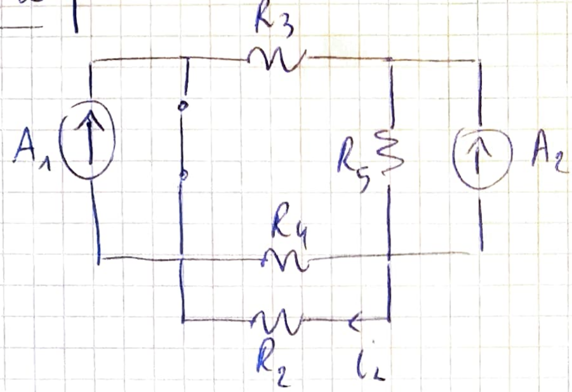
Req



$R_{eq} = (R_3 + R_5) \,//\, R_4 + R_2 = \frac{13}{3}\ \Omega$

$\tau = \frac{L}{R_{eq}} = \frac{9}{13}$ s

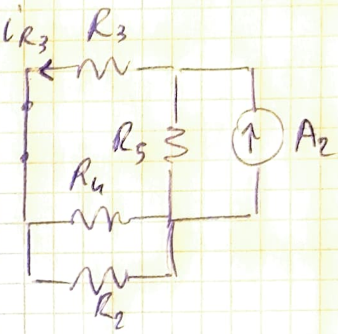
$\boxed{t = \infty}$



$v_L(\infty) = 0 \ V$

Sovrapposizione effetti:

$A_1 = 0$



$$R_{234} = \frac{R_2 R_4}{R_2 + R_4} + R_3 = \frac{11}{5} \ \Omega$$

Partitore corrente:

$$i_{R_3} = A_2 \frac{R_5}{R_5 + R_{234}} = \frac{45}{26} \ A$$

Partitore corrente:

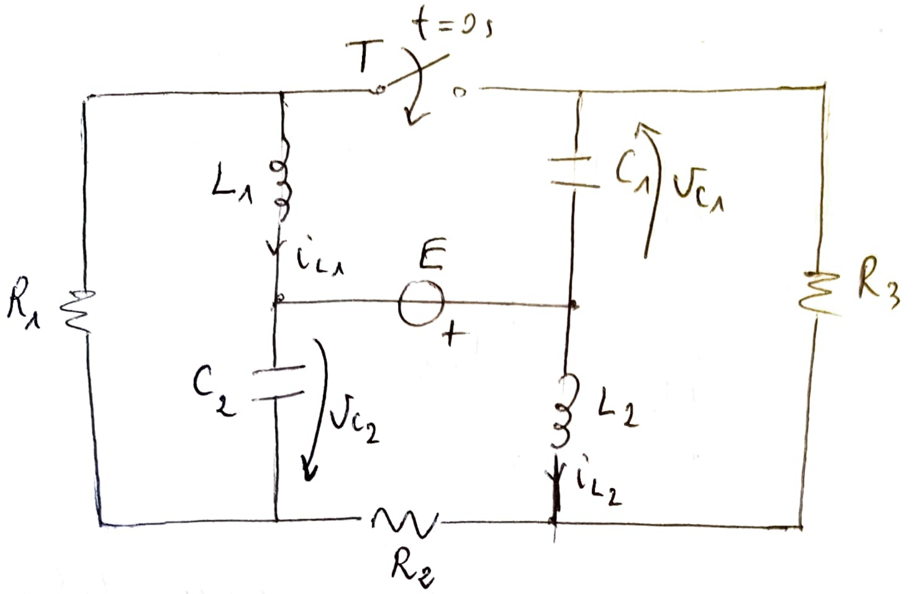
$$i_L' = - i_{R_3} \frac{R_4}{R_4 + R_2} = -\frac{9}{13} \ A$$

$A_2 = 0$ $\Rightarrow$ $i_L'' = 0 \ A$

$$\Rightarrow i_L = -\frac{9}{13} \ A$$

$$\Rightarrow \begin{cases} v_L(t) = -3 e^{-\frac{13}{9} t} & [V] \\ i_L(t) = \frac{9}{13} e^{-13t/9} - \frac{9}{13} & [A] \end{cases}$$

③ ESERCIZIO SU TRANSITORI – METODO DI ISPEZIONE



DATI:

$R_1 = 1\,\Omega$
$R_2 = 2\,\Omega$
$R_3 = 3\,\Omega$
$C_1 = 1\,\mu F$
$C_2 = 2\,\mu F$
$L_1 = 4\,mH$
$L_2 = 1\,mH$
$E = 12\,V$

$t = 0^-$: RETE IN CONDIZIONI DI REGIME CON "T" APERTO

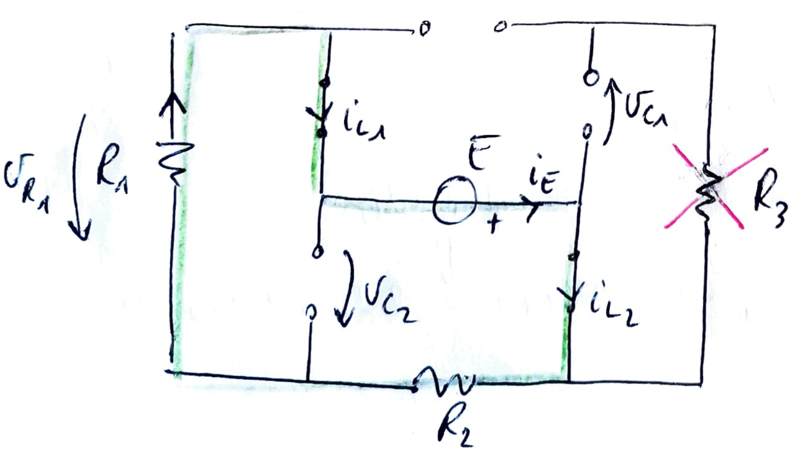
DETERMINARE:

POTENZA EROGATA DAL GENERATORE "E" AGLI ISTANTI:

A) $t = 0^-$; B) $t = 0^+$; C) $t \to \infty$

RISOLUZIONE:

A) $\boxed{t = 0^-}$



$$I_{L10} = I_{L20} = \frac{E}{R_1 + R_2} = \frac{12}{1+2} = 4A$$

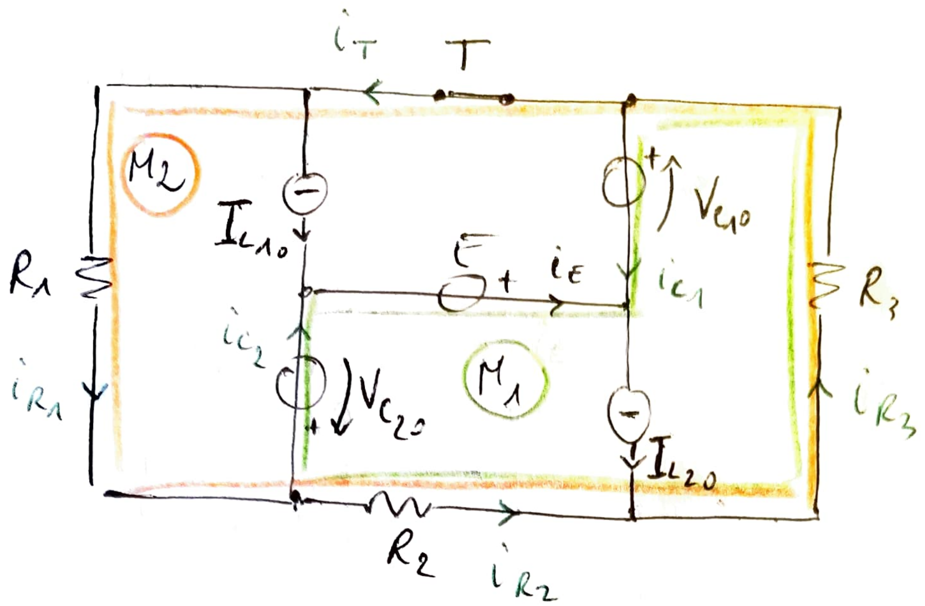
$$\Rightarrow i_E(0^-) = I_{L10} = 4A$$

$$\Rightarrow p_E(0^-) = E \cdot i_E(0^-) = 48\,W$$

$$v_{C1}(0^-) = V_{C10} = v_{R3} = 0\,V$$

$$v_{C2}(0^-) = V_{C20} = v_{R1} = R_1 I_{L10} = 4V$$

B) $\boxed{t = 0^+}$



$I_{L10} = I_{L20} = 4\,A$

$V_{C10} = 0\,V$

$V_{C20} = 4\,V$

NELLO SCRIVERE LE LKT, CONSIDERIAMO DUE MAGLIE (M_1 & M_2) PRIVE DEI GENERATORI DI CORRENTE, CHE INTRODURREBBERO ULTERIORI INCOGNITE.

SCRIVIAMO INNANZITUTTO LE LKC ESPRIMENDO TUTTE LE CORRENTI IN FUNZIONE DI i_{R1} e i_E:

(1) $i_T = i_{R1} + I_{L10}$

(2) $i_{C2} = i_E - I_{L10}$

(3) $i_{C1} = I_{L20} - i_E$

(4) $i_{R2} = i_{R1} - i_{C2} \underset{(2)}{=} i_{R1} - i_E + I_{L10}$

(5) $i_{R3} = I_{L20} + i_{R2} \underset{(4)}{=} I_{L20} + i_{R1} - i_E + I_{L10} \overset{I_{L10} = I_{L20}}{=} 2I_{L10} + i_{R1} - i_E$

LKT:

$M_1 \Rightarrow \quad E = -V_{C10} - i_{R3}R_3 - i_{R2}R_2 + V_{C20}$

$\Rightarrow \quad E = -V_{C10} - (2I_{L10} + i_{R1} - i_E)R_3 - (i_{R1} - i_E + I_{L10})R_2 + V_{C20}$

$(M_2) \Rightarrow i_{R_1} R_1 = -i_{R_3} R_3 - i_{R_2} R_2$

$$\Rightarrow i_{R_1} R_1 = -(2 I_{L_1 0} + i_{R_1} - i_E) R_3 - (i_{R_1} - i_E + I_{L_1 0}) R_2$$

$$\Rightarrow \begin{cases} (6) \quad E = -V_{C_1 0} - (2 I_{L_1 0} + i_{R_1} - i_E) R_3 - (i_{R_1} - i_E + I_{L_1 0}) R_2 + V_{C_2 0} \\ (7) \quad i_{R_1} R_1 = -(2 I_{L_1 0} + i_{R_1} - i_E) R_3 - (i_{R_1} - i_E + I_{L_1 0}) R_2 \end{cases}$$

↳ DIFFERENZA TRA LE DUE EQUAZIONI : (7) − (6) :

$$i_{R_1} R_1 - E = V_{C_1 0} - V_{C_2 0} \Rightarrow \boxed{i_{R_1} = \frac{\cancelto{0}{V_{C_1 0}} - V_{C_2 0} + E}{R_1} = 8 \text{ A}}$$

(OTTENIBILE ANCHE APPLICANDO LKT A MAGLIA COMPOSTA DA R_1, C_1, E, C_2)

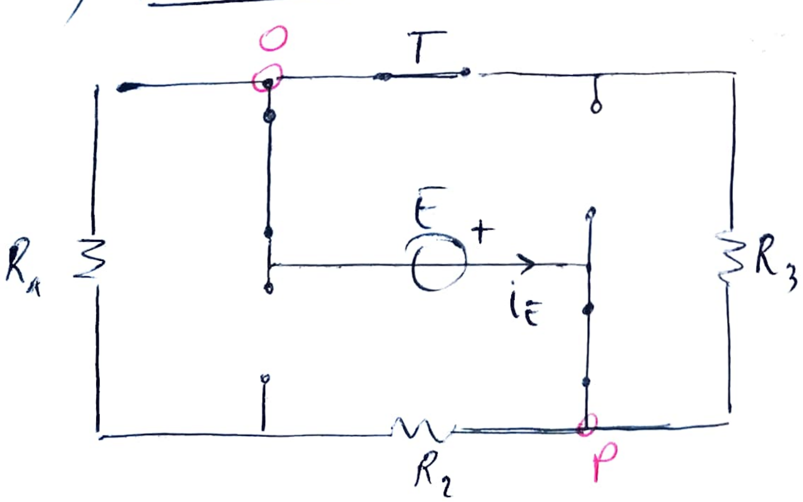
$$(7) \Rightarrow i_E [R_3 + R_2] = i_{R_1} R_1 + i_{R_1} R_3 + 2 I_{L_1 0} R_3 + i_{R_1} R_2 + I_{L_1 0} R_2$$

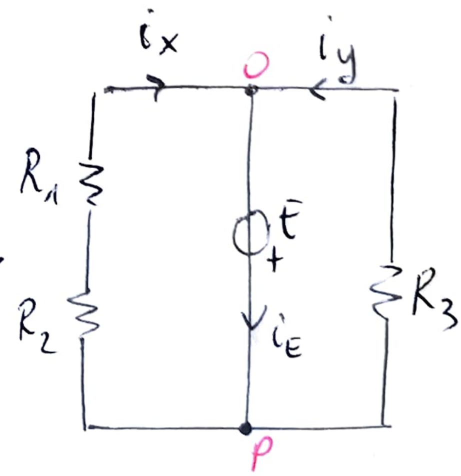
$$\Rightarrow i_E = \frac{i_{R_1}(R_1 + R_2 + R_3) + I_{L_1 0}(2 R_3 + R_2)}{R_2 + R_3}$$

$$= \frac{8 \cdot (1 + 2 + 3) + 4 \cdot (2 \cdot 3 + 2)}{2 + 3} = 16 \text{ A}$$

$$\Rightarrow p_E(0^+) = i_E E = 16 \cdot 12 = 192 \text{ W}$$

c) $\boxed{t \to \infty}$



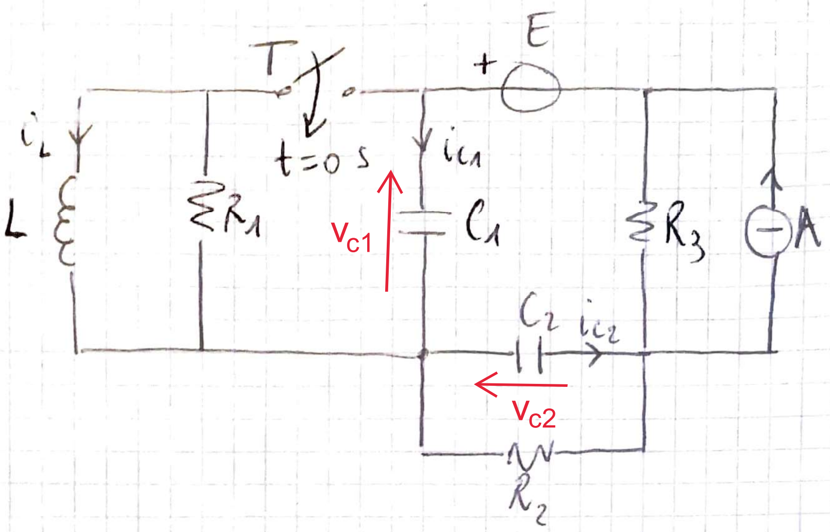


DATO CHE $R_1 + R_2 = 3\,\Omega = R_3 \Rightarrow i_x = i_y = \frac{E}{R_3} = \frac{12}{3} = 4 \text{ A}$

LKC (NODO "O") $\Rightarrow i_E = i_x + i_y = 8 \text{ A} \Rightarrow p_E(\infty) = E\, i_E = 8 \cdot 12 = 96 \text{W}$

ESERCIZIO 4

ESERCIZIO su TRANSITORI - METODO di ISPEZIONE



Dati:

$L = 2\,H$

$C_1 = 2\,F$

$C_2 = 3\,F$

$R_1 = 1\,\Omega$

$R_2 = 3\,\Omega$

$R_3 = 2\,\Omega$

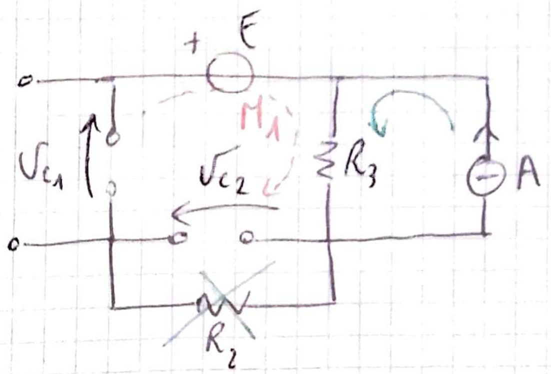
$E = 3\,V$

$A = 2\,A$

Calcolare:

- $t = 0^-$: W_L, W_{C_1}, W_{C_2}
- $t = 0^+$: $\frac{di_L}{dt}$, potenza erogata da generatore E (P_E)
- $t = \infty$: Q_{C_1}, Q_{C_2}, W_L, W_{C_1}, W_{C_2}

$t = 0^-$



$i_L(0^-) = 0\,A$

$i_{R_2} = 0\,A \Rightarrow v_{R_2} = 0 \Rightarrow v_{C_2} = 0\,V$

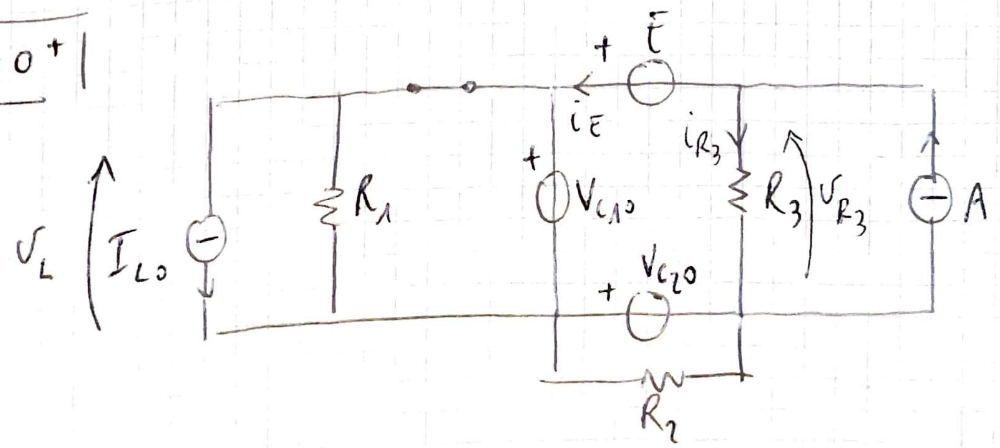
$v_{R_3} = A \cdot R_3 = 4\,V$

LKT M_1 : $v_{C_1} - E - v_{R_3} + \cancel{v_{C_2}}^{\,0} = 0 \Rightarrow v_{C_1} \overset{!}{=} E + v_{R_3} = 7\,V$

$v_{C_1} \overset{!}{=} V_{C_{10}}$

$W_L = 0\,J$; $W_{C_1} = \frac{1}{2} C_1 V_{C_{10}}^2 = 49\,J$; $W_{C_2} = 0\,J$

$t = 0^+$



$v_L(0^+) = V_{C_{10}} = 7\ V$

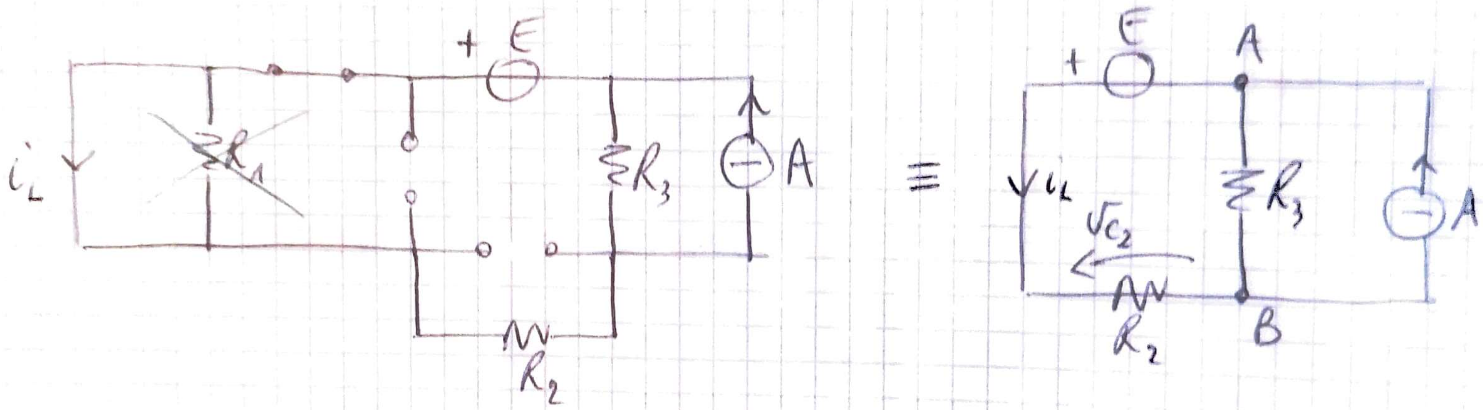
$$\Rightarrow \left.\frac{di_L}{dt}\right|_{0^+} = \frac{v_L}{L} = \frac{7}{2} = 3.5\ A/s$$

$V_{C_{20}} = v_{C_2}(0^-) = v_{C_2}(0^+) = 0\ V \Rightarrow v_{R_3} = V_{C_{10}} - E = 4\ V$

$$\Rightarrow i_{R_3} = \frac{v_{R_3}}{R_3} = 2\ A$$

KC: $i_E = -i_{R_3} + A = 0\ A \Rightarrow P_E = E \cdot i_E = 0\ W$

$\boxed{t = \infty}$



$v_{C_1}(t=\infty) = 0\ V \Rightarrow Q_{C_1} = v_{C_1} C_1 = 0\ C$

Millman: $$v_{AB} = \frac{-E/R_2 + A}{\frac{1}{R_2} + \frac{1}{R_3}} = \frac{6}{5}\ V$$

$\Rightarrow v_{C_2}(t=\infty) = E + v_{AB} = \frac{21}{5}\ V \rightarrow Q_{C_2} = v_{C_2} C_2 = \frac{63}{5}\ C$

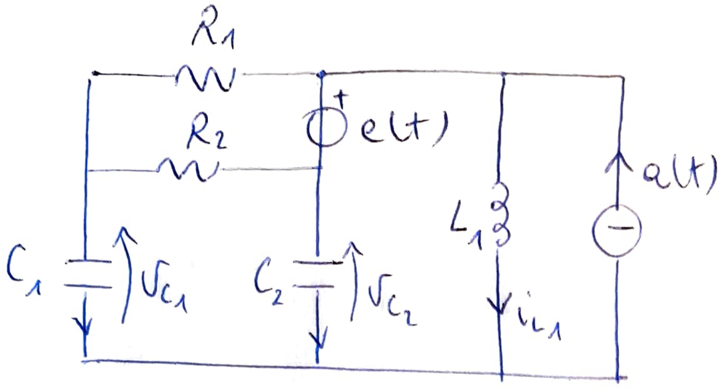
Ohm: $i_L = \frac{v_{C_2}}{R_2} = \frac{7}{5}\ A$

$W_{C_1} = \frac{1}{2} C_1 v_{C_1}^2(t=\infty) = 0\ J$

$W_{C_2} = \frac{1}{2} C_2 v_{C_2}^2(t=\infty) = 26.46\ J$

$W_L = \frac{1}{2} L\, i_L^2(t=\infty) = 1.96\ J$

(5) ESERCIZIO SU REGIME SINUSOIDALE



DATI:

$R_1 = 3\,\Omega$; $R_2 = 1\,\Omega$

$L_1 = 1\,H$; $C_1 = 3\,F = C_2$

$e(t) = 3\sin(t + 105°)\ V$

$a(t) = 3\sin(t - 60°)\ A$

$\omega = 1\ rad/s$

DETERMINARE $i_{L_1}(t)$

RISOLUZIONE:

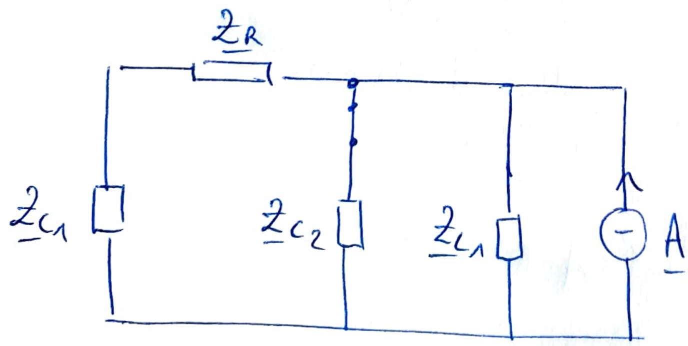
$\underline{Z}_{R_1} = 3\,\Omega$; $\underline{Z}_{R_2} = 1\,\Omega$; $\underline{Z}_{L_1} = j\,\Omega$; $\underline{Z}_{C_1} = \underline{Z}_{C_2} = -\frac{j}{3}\,\Omega$

CONVENZIONE COSENO A FASE NULLA $\rightarrow$ $e(t) = 3\cos(t + 15°)\ V$
$a(t) = 3\cos(t - 150°)\ A$

$$\Rightarrow \quad \underline{E} = \frac{3}{\sqrt{2}} \angle 15°\ V$$
$$\underline{A} = \frac{3}{\sqrt{2}} \angle -150°\ A$$

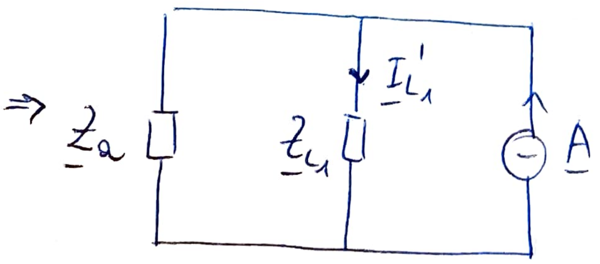
APPLICO PRINCIPIO di SOVRAPPOSIZIONE degli EFFETTI:

$\rightarrow$ $a(t) \neq 0$



$$\underline{Z}_R = \underline{Z}_{R_1} \parallel \underline{Z}_{R_2} = \frac{\underline{Z}_{R_1}\underline{Z}_{R_2}}{\underline{Z}_{R_1}+\underline{Z}_{R_2}} = \frac{3}{4}\,\Omega$$

$\Rightarrow$

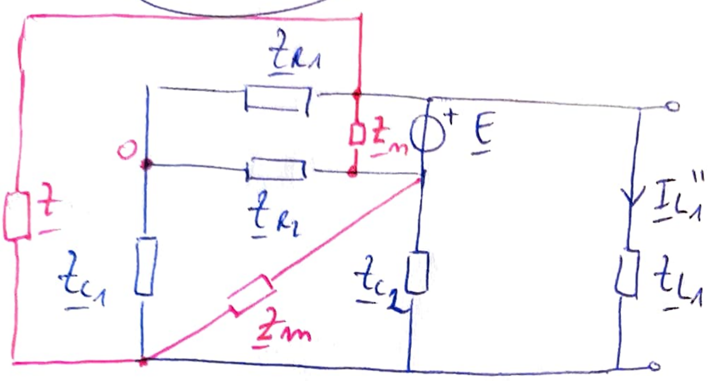


$$\underline{Z}_a = \left[(\underline{Z}_{C_1} + \underline{Z}_R) \parallel \underline{Z}_{C_2}\right] = \frac{(\underline{Z}_{C_1} + \underline{Z}_R)\underline{Z}_{C_2}}{\underline{Z}_{C_1} + \underline{Z}_R + \underline{Z}_{C_2}} = 0{,}27263\angle -72{,}329°\ (\Omega)$$

PARTITORE DI CORRENTE:

$$\Rightarrow \underline{I}'_{L_1} = \underline{A}\,\frac{\underline{Z}_e}{\underline{Z}_e + \underline{Z}_{L_1}} = \frac{3}{\sqrt{2}}\angle 150^\circ\,\frac{\underline{Z}_e}{\underline{Z}_e + j} = 0,77645\,\angle 54,050^\circ\ \text{A}$$

$\rightarrow e(t) \neq 0$



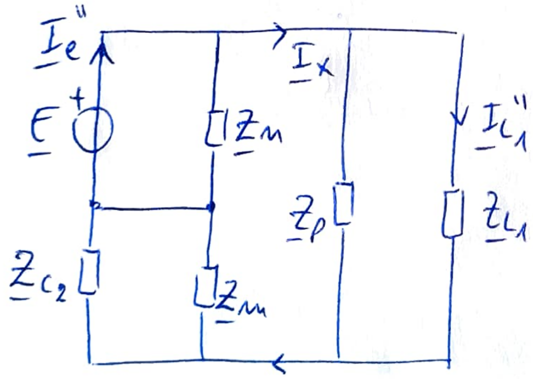
$Y \rightarrow \Delta$:

$$\underline{Z}_p = \frac{\underline{Z}_{R_1}\underline{Z}_{R_2} + \underline{Z}_{R_1}\underline{Z}_{C_1} + \underline{Z}_{C_1}\underline{Z}_{R_2}}{\underline{Z}_{R_2}} = 3,2830\,\angle -23,962^\circ\ \Omega$$

$$\underline{Z}_m = \frac{\underline{Z}_{R_1}\underline{Z}_{R_2} + \underline{Z}_{R_1}\underline{Z}_{C_1} + \underline{Z}_{C_1}\underline{Z}_{R_2}}{\underline{Z}_{R_1}} = 1,0943\,\angle -23,962^\circ\ \Omega$$

$$\underline{Z}_n = \frac{\underline{Z}_{R_1}\underline{Z}_{R_2} + \underline{Z}_{R_1}\underline{Z}_{C_1} + \underline{Z}_{C_1}\underline{Z}_{R_2}}{\underline{Z}_{C_1}} = 9,8489\,\angle 66,038^\circ\ \Omega$$

RIDISEGNO IL CIRCUITO:

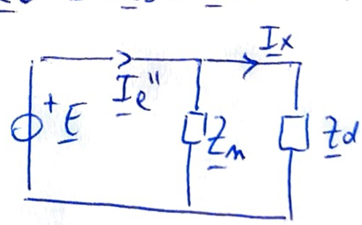


$$\underline{Z}_b = \underline{Z}_{L_1} /\!/ \underline{Z}_p = 1,0876\,\angle 72,378^\circ\ \Omega$$

$$\underline{Z}_c = \underline{Z}_n /\!/ \underline{Z}_{C_2} = 0,28793\,\angle -76,087^\circ\ \Omega$$

$$\underline{Z}_d = \underline{Z}_b + \underline{Z}_c = 0,85555\,\angle 62,240^\circ\ \Omega$$

$\Rightarrow$



$$\underline{Z}_e = \underline{Z}_d /\!/ \underline{Z}_m = 0,78730\,\angle 62,543^\circ\ \Omega$$

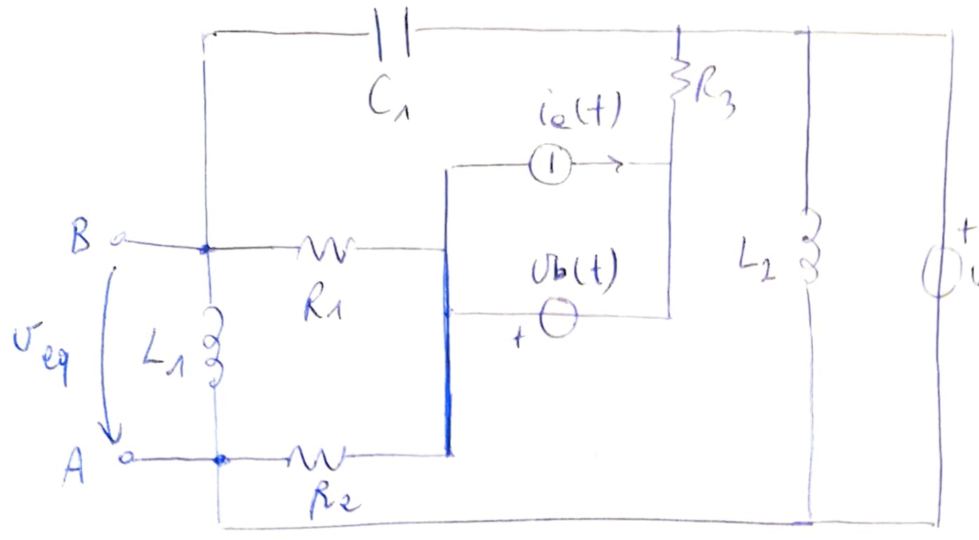
$$\Rightarrow \underline{I}''_e = \frac{E}{\underline{Z}_e} = 2,6944\,\angle -47,543^\circ\ \text{A}$$

PARTITORE DI CORRENTE: $\underline{I}_x = \underline{I}''_e\,\dfrac{\underline{Z}_m}{\underline{Z}_m + \underline{Z}_d} = 2,4795\,\angle -47,240^\circ\ \text{A}$

$$\Rightarrow \underline{I}''_{L_1} = \frac{\underline{Z}_p}{\underline{Z}_p + \underline{Z}_{L_1}}\,\underline{I}_x = 2,6968\,\angle -64,862^\circ\ \text{A}$$

$$\Rightarrow \underline{I}_{L_1} = \underline{I}'_{L_1} + \underline{I}''_{L_1} = 2,4189\,\angle -48,543^\circ\ \text{A} \Rightarrow \boxed{i_{L_1}(t) = 3,42\cos(t - 48,5^\circ)\ \text{A}}$$

(6) ESERCIZIO IN REGIME SINUSOIDALE



DATI:

$R_1 = R_2 = 1\,\Omega$

$R_3 = 3\,\Omega$

$L_1 = 1\,H$

$L_2 = 3\,H$

$C_1 = 1\,F$

$i_a(t) = 3\cos(3t - 75°)\ A$

$v_b(t) = 3\sin(3t + 105°)\ V$

$v_c(t) = 2\cos(3t - 165°)\ V$

$\omega = 3\ rad/s$

DETERMINARE CIRCUITO EQUIV. DI THEVENIN AI TERMINALI A e B

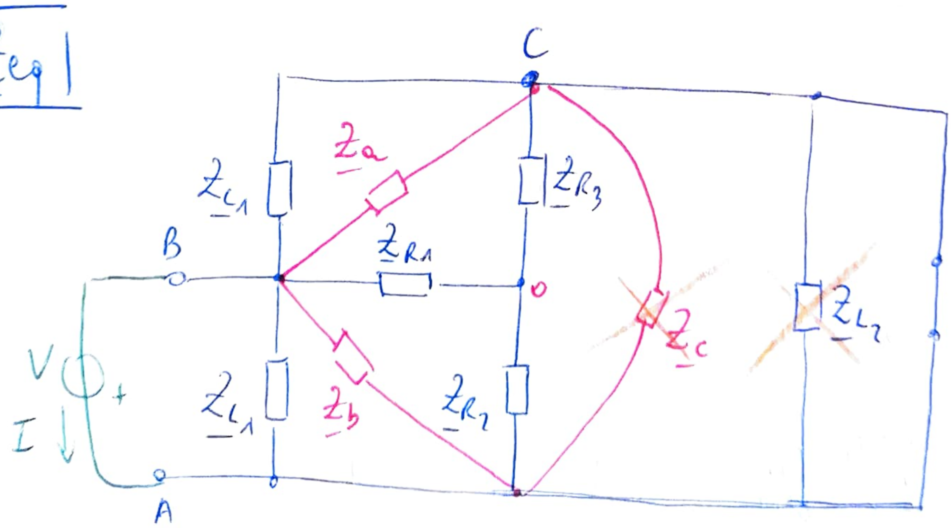
RISOLUZIONE:

CONVENZIONE del COSENO A FASE NULLA $\rightarrow v_b(t) = 3\cos(3t + 15°)\ V$

$\underline{I_a} = \frac{3}{\sqrt{2}} \angle -75° \ (A) \qquad \underline{V_b} = \frac{3}{\sqrt{2}} \angle 15° \ (V) \qquad \underline{V_c} = \frac{2}{\sqrt{2}} \angle -165° \ (V)$

$\underline{Z}_{R_1} = \underline{Z}_{R_2} = 1\ \Omega \ ; \ \underline{Z}_{R_3} = 3\ \Omega \ ; \ \underline{Z}_{L_1} = j3\ \Omega \ ; \ \underline{Z}_{L_2} = j9\ \Omega \ ; \ \underline{Z}_{C_1} = -\frac{j}{3}\ \Omega$

$\boxed{\underline{Z}_{eq}}$

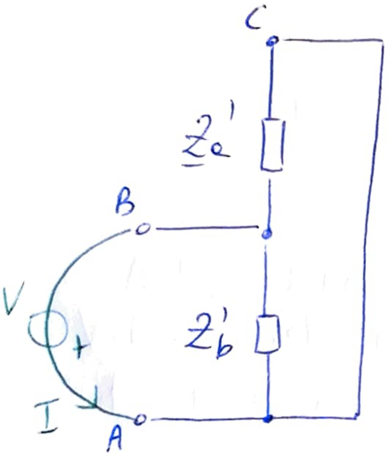


$Y \rightarrow \Delta$

$\underline{Z}_a = \frac{\underline{Z}_{R_1}\underline{Z}_{R_2} + \underline{Z}_{R_2}\underline{Z}_{R_3} + \underline{Z}_{R_1}\underline{Z}_{R_3}}{\underline{Z}_{R_2}} = 7\,\Omega \ ; \ \underline{Z}_b = \frac{\underline{Z}_{R_1}\underline{Z}_{R_2} + \underline{Z}_{R_2}\underline{Z}_{R_3} + \underline{Z}_{R_1}\underline{Z}_{R_3}}{\underline{Z}_{R_3}} = \frac{7}{3}\,\Omega$

$$\underline{Z}_e' = \underline{Z}_{C_1} \parallel \underline{Z}_e = \frac{\underline{Z}_{C_1}\underline{Z}_e}{\underline{Z}_{C_1}+\underline{Z}_e} = 0{,}015837 - j0{,}33258 \ (\Omega)$$

$$\underline{Z}_b' = \underline{Z}_{L_1} \parallel \underline{Z}_b = 1{,}4538 + j\,1{,}1308 \ (\Omega)$$

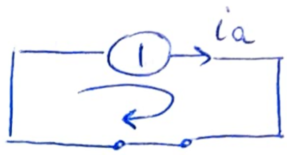


$$A \equiv C \Rightarrow \underline{Z}_{eq} = \underline{Z}_e' \parallel \underline{Z}_b' = \frac{\underline{Z}_e'\underline{Z}_b'}{\underline{Z}_e'+\underline{Z}_b'} = 0{,}0768 - j\,0{,}359 \ (\Omega)$$

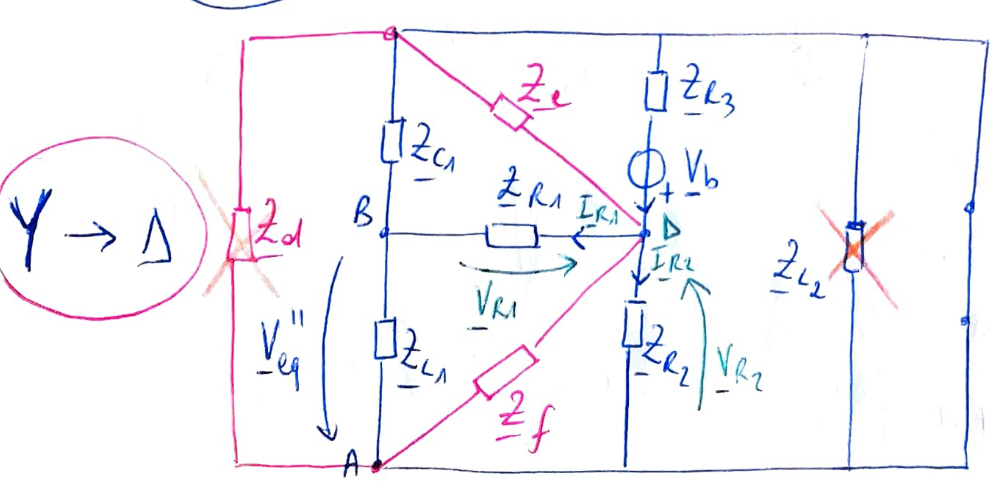
$\boxed{\underline{V}_{eq}}$ APPLICO PRINCIPIO DI SOVRAPPOSIZIONE

→ $i_a \neq 0$ ⇒ L'UNICA MAGLIA DOVE CIRCOLA CORRENTE È QUELLA FORMATA DA $i_a(t)$ ED IL CORTOCIRCUITO OTTENUTO DISATTIVANDO $v_b(t)$

⇒ NON CIRCOLA CORRENTE SU $\underline{Z}_{L_1}$ ⇒ $\underline{V}_{eq}' = 0$ V



→ $v_b \neq 0$

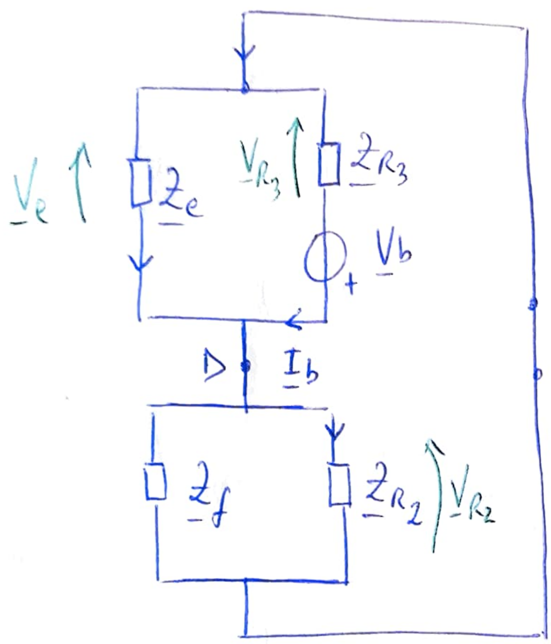


$$\underline{V}_{eq}'' = \underline{V}_{R_1} - \underline{V}_{R_2}$$

$$\underline{Z}_e = \frac{\underline{Z}_{C1}\underline{Z}_{R1} + \underline{Z}_{R1}\underline{Z}_{L1} + \underline{Z}_{C1}\underline{Z}_{L1}}{\underline{Z}_{L1}} = \frac{\sqrt{73}}{9}\,\underline{/-20,556^\circ}\ (\Omega)$$

$$\underline{Z}_f = \frac{\underline{Z}_{C1}\underline{Z}_{R1} + \underline{Z}_{R1}\underline{Z}_{L1} + \underline{Z}_{C1}\underline{Z}_{L1}}{\underline{Z}_{C1}} = \sqrt{73}\,\underline{/159,44^\circ}\ (\Omega)$$

RIDISEGNO IL CIRCUITO:



$$\underline{Z}_x = (\underline{Z}_f \,//\, \underline{Z}_{R_2}) \,//\, \underline{Z}_e = (1,1207 + j\,0,051733) \,//\, \underline{Z}_e = 0,52486\,\underline{/-9,9362^\circ}\ (\Omega)$$

$$\Rightarrow \underline{I}_b = \frac{\underline{V}_b}{\underline{Z}_x + \underline{Z}_{R_3}} = 0,60296\,\underline{/16,475^\circ}\ (A)$$

$$\underline{V}_{R_3} = \underline{Z}_{R_3} \cdot \underline{I}_b = 3\,\underline{I}_b = 1,8089\,\underline{/16,475^\circ}\ (V)$$

LKT: $\underline{V}_e = \underline{V}_{R_3} - \underline{V}_b = 0,31650\,\underline{/-173,45^\circ}\ (V)$

$$\underline{V}_{R_2} = -\underline{V}_e = 0,31650\,\underline{/6,5400^\circ}\ (V)$$

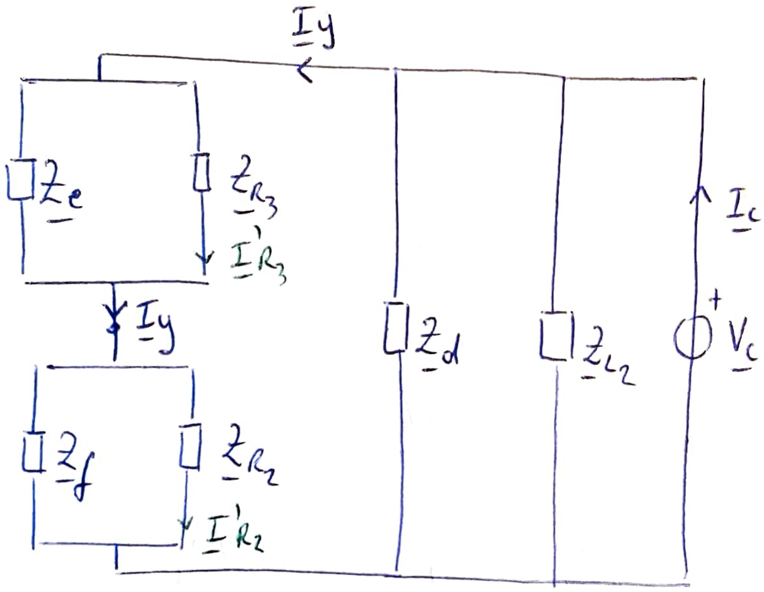
LKC (NODO D): $\underline{I}_{R_1} = \underline{I}_b - \underline{I}_{R_2} = \underline{I}_b - \dfrac{\underline{V}_{R_2}}{\underline{Z}_{R_2}} = 0,29628\,\underline{/27,096^\circ}\ (A)$

(VEDI CIRCUITO ALLA PAGINA PRECEDENTE) $\Rightarrow \underline{V}_{R_1} = \underline{I}_{R_1}$

LKT: $\underline{V}_{eq}'' = \underline{V}_{R_1} - \underline{V}_{R_2} = 0,11113\,\underline{/117,13^\circ}\ (V)$

→ $V_c \neq 0$

$$\underline{Z}_d = \frac{\underline{Z}_{C1}\underline{Z}_{R1} + \underline{Z}_{R1}\underline{Z}_{L1} + \underline{Z}_{C1}\underline{Z}_{L1}}{\underline{Z}_{R1}} = \frac{\sqrt{73}}{3}\,\angle 63{,}444° \ (\Omega)$$



$$\underline{Z}_y = \underline{Z}_e \parallel \underline{Z}_{R_3} + \underline{Z}_f \parallel \underline{Z}_{R_2} = 1{,}8291\,\angle -4{,}5528° \ (\Omega)$$

$$\underline{Z}_d' = \underline{Z}_d \parallel \underline{Z}_{L_2} = 2{,}1890\,\angle 74{,}343° \ (\Omega)$$

$$\underline{Z}_t = \underline{Z}_y \parallel \underline{Z}_d' = 1{,}2869\,\angle 39{,}680° \ (\Omega)$$

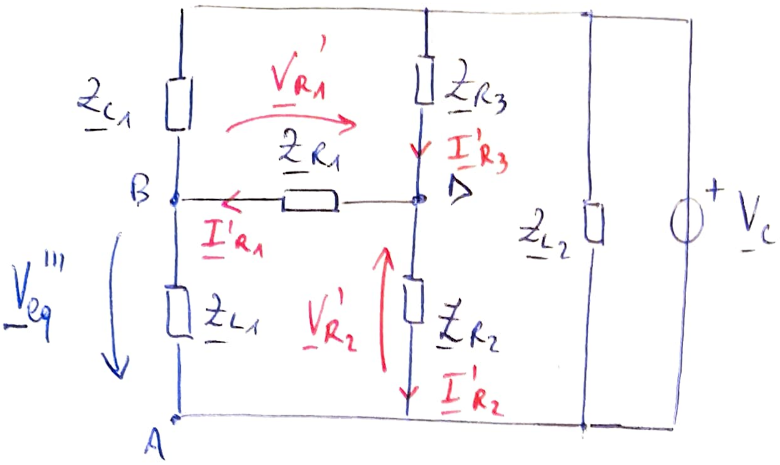
$$\Rightarrow \underline{I}_c = \frac{\underline{V}_c}{\underline{Z}_t} = \frac{\frac{2}{\sqrt{2}}\angle -165°}{\underline{Z}_t} = 1{,}0989\,\angle 164{,}32° \ (A)$$

$$\Rightarrow \underline{I}_y = \underline{I}_c \frac{\underline{Z}_d'}{\underline{Z}_d' + \underline{Z}_y} = 0{,}77317\,\angle -160{,}45° \ (A)$$

$$\underline{I}'_{R_3} = \underline{I}_y \frac{\underline{Z}_e}{\underline{Z}_e + \underline{Z}_{R_3}} = 0{,}18805\,\angle -176{,}11° \ (A)$$

$$\underline{I}'_{R_2} = \underline{I}_y \frac{\underline{Z}_f}{\underline{Z}_f + \underline{Z}_{R_2}} = 0{,}86740\,\angle -157{,}81° \ (A)$$

PARTITORI DI CORRENTE



$\underline{V}'_{R_2} = \underline{I}'_{R_2}$

$\underline{I}'_{R_1} = \underline{I}'_{R_3} - \underline{I}'_{R_2} = 0,69139 \angle 27,089^\circ$ (A)

$\underline{V}'_{R_1} = \underline{I}'_{R_1}$ $\underset{LKT}{\Longrightarrow}$ $\underline{V}'''_{eq} = \underline{V}'_{R_1} - \underline{V}'_{R_2} = 1,5574 \angle 24,363^\circ$ (V)

$\Rightarrow \underline{V}_{eq} = \underline{V}'_{eq} + \underline{V}''_{eq} + \underline{V}'''_{eq} = 1,5560 \angle 28,454^\circ$ (V)

$\simeq 1,56 \angle 28,5^\circ$ (V)