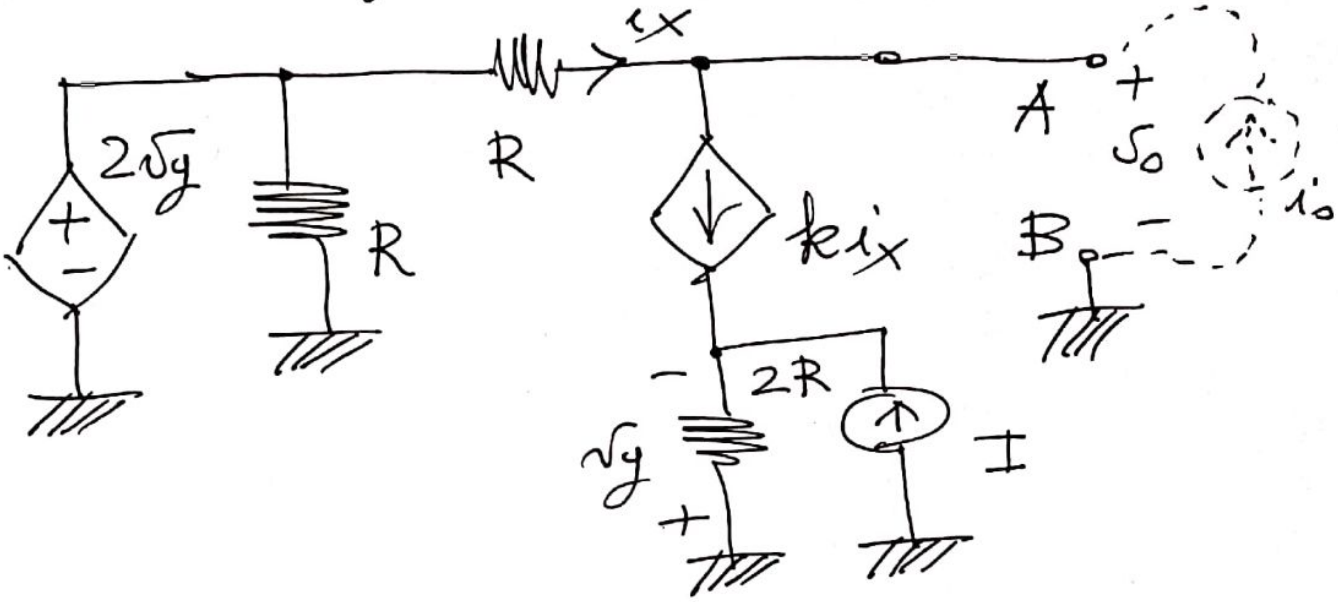
Esempio ? Thevenin bipolo AB con metodo rapido. Il parametro $k \in \mathbb{R}$.



Soluzione Si ha

$$i_x + i_o = k i_x$$

$$(k-1) i_x = i_o$$

1) $k = 1 \Rightarrow i_o = 0 \Rightarrow$ il bipolo non è controllabile in corrente.

2) $k \neq 1 \Rightarrow i_x = -\dfrac{i_o}{1-k}$

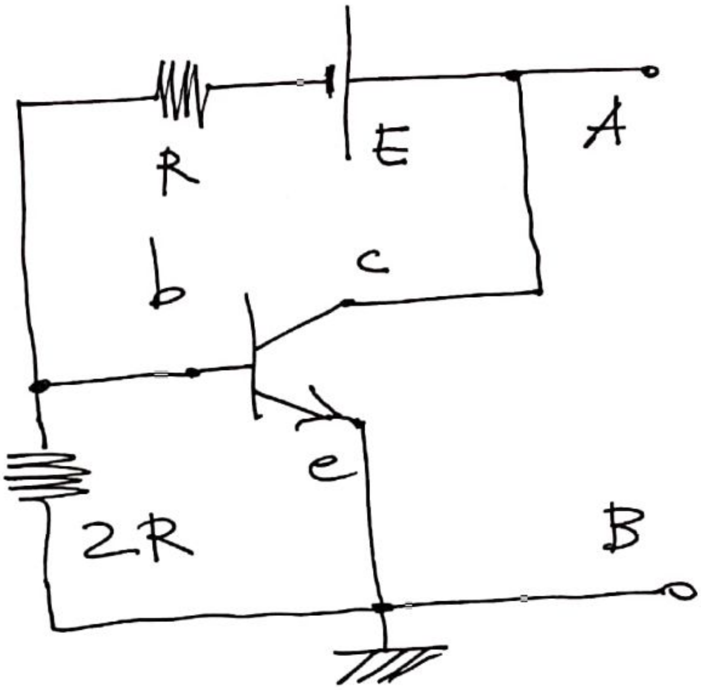
$$v_y = -(I + k i_x) 2R = -2RI - 2Rk i_x$$

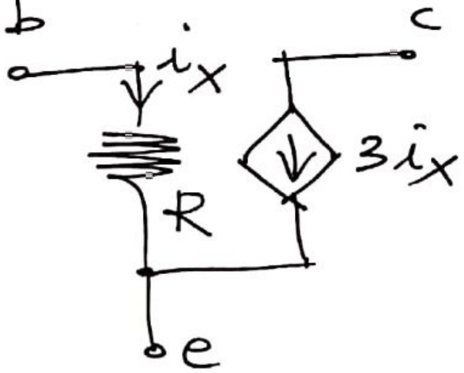
$$v_y = -2RI + 2R \frac{k}{1-k} i_o$$

$$v_o = -R i_x + 2v_y = \frac{R i_o}{1-k} - 4RI + 4R \frac{k}{1-k} i_o$$

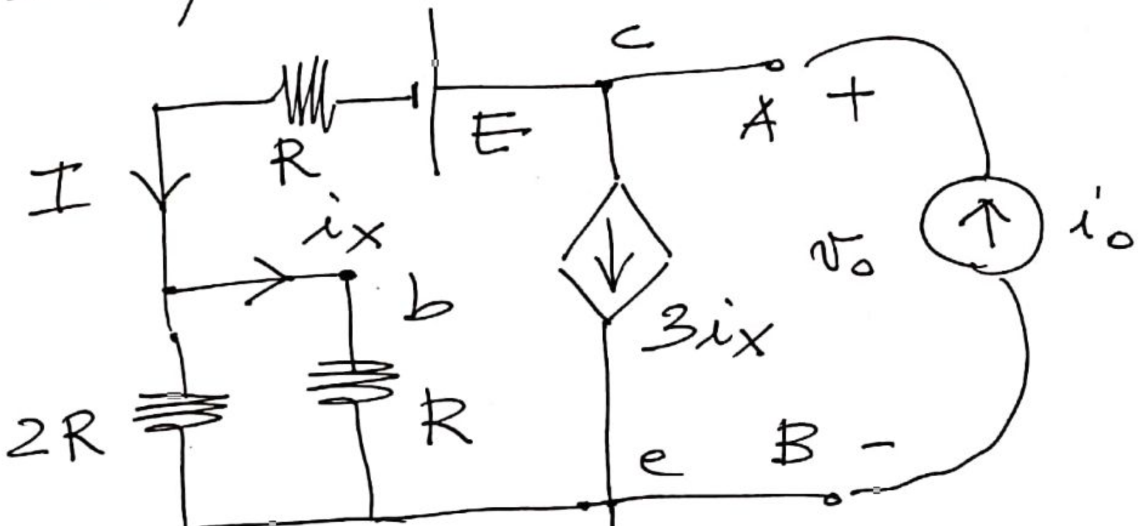
$$v_o = \underbrace{-4RI}_{v_{eq}} + \underbrace{\frac{R}{1-k}[1+4k]}_{R_{eq}} i_o; \text{ per } k \neq 1.$$

Esempio ? Thevenin bipolo AB





Soluzione. Con 'metodo rapido'

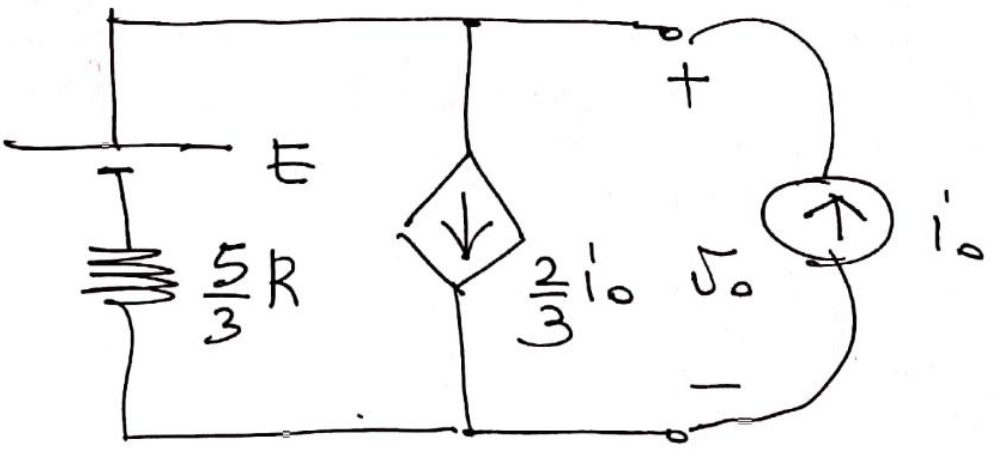


Si ha: $I = i_0 - 3i_x$

$i_x = \frac{2}{3} I \Rightarrow$

$\frac{3}{2} i_x = i_0 - 3i_x \Rightarrow$

$$\boxed{i_x = \frac{2}{9} i_0}$$

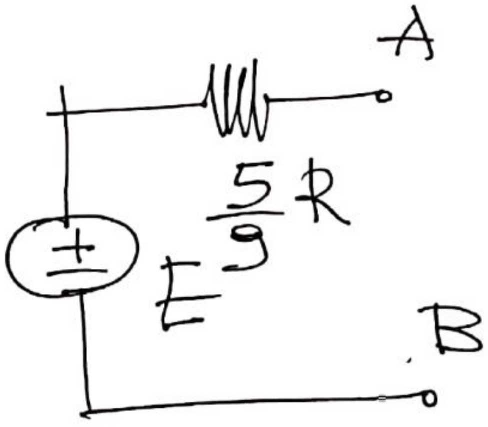


Per Millmann:

$$v_o = \frac{E\frac{3}{5R} - \frac{2}{3}i_o + i_o}{\frac{3}{5R}}$$

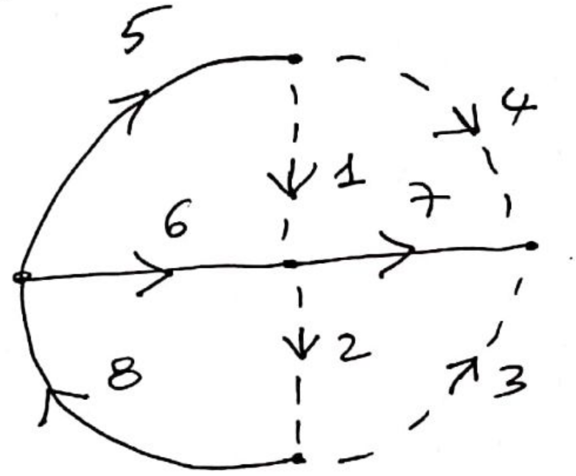
$$\frac{3}{5R} v_o = \frac{3}{5R} E + \frac{1}{3} i_o$$

$$v_o = \underbrace{E}_{V_{eq}} + \underbrace{\frac{5}{9}R}_{R_{eq}} i_o$$

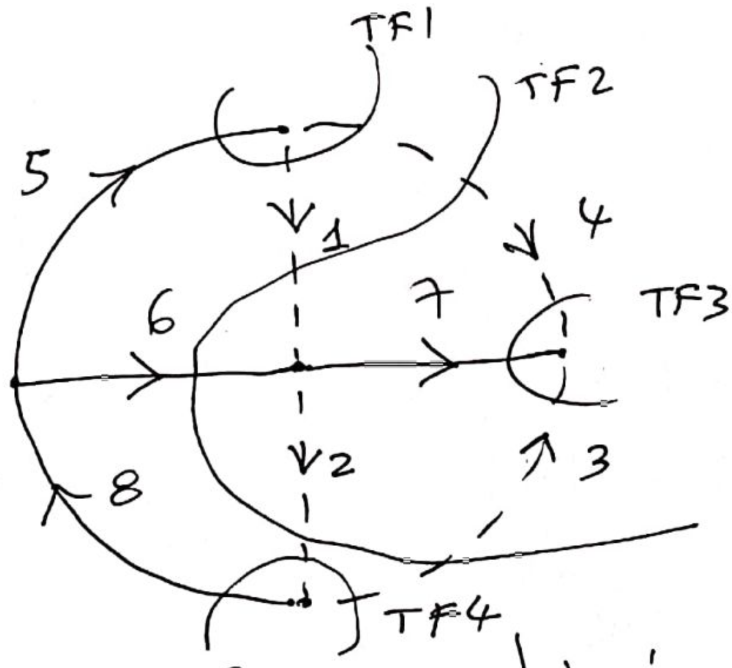


①

Esempio Determinare le matrici topologiche $\underline{A}$ dei tagli fondamentali e $\underline{B}$ delle maglie fondamentali per il grafo orientato in figura.



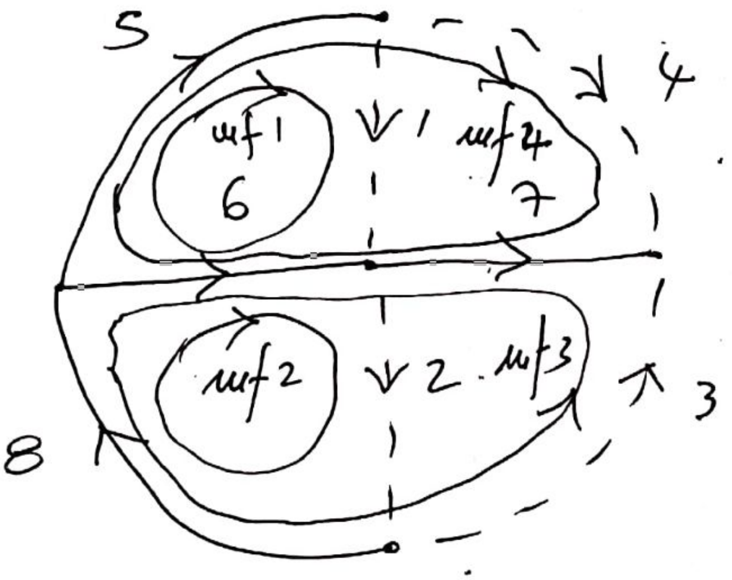
Soluzione



$$\underline{i}_c = \{i_1, i_2, i_3, i_4\} \quad ; \quad \underline{i}_g = \{i_5, i_6, i_7, i_8\}$$

$$KI_{tf} \begin{cases} i_5 = i_1 + i_4 \\ i_6 = -i_1 + i_2 - i_3 - i_4 \\ i_7 = -i_3 - i_4 \\ i_8 = i_2 - i_3 \end{cases}$$

$$\underline{i}_q = \underline{\underline{A}}\,\underline{i}_c \qquad \underline{\underline{A}} = \begin{pmatrix} 1 & 0 & 0 & 1 \\ -1 & 1 & -1 & -1 \\ 0 & 0 & -1 & -1 \\ 0 & -1 & -1 & 0 \end{pmatrix}$$



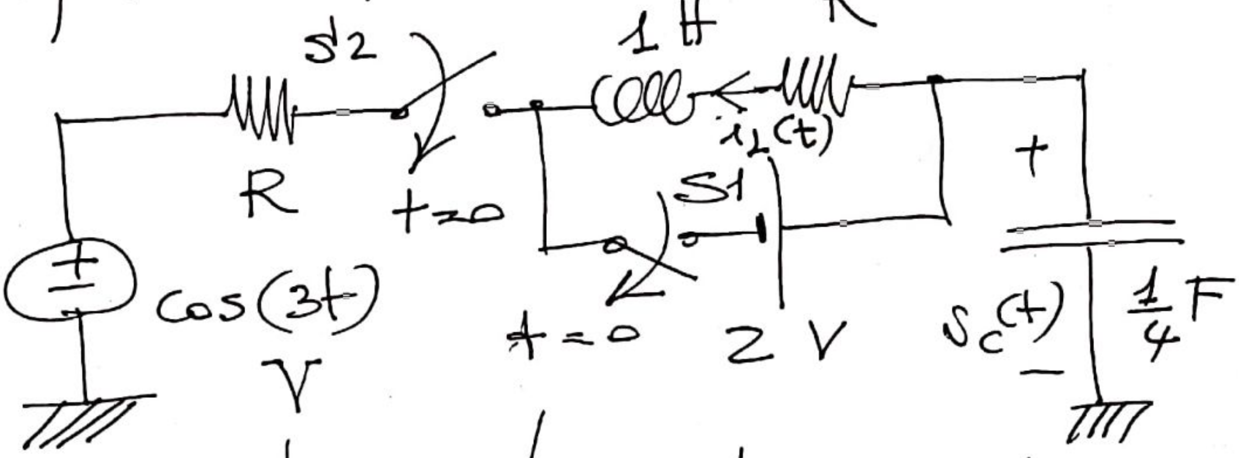
KV mf
$$\begin{cases} v_1 = -v_5 + v_6 \\ v_2 = -v_6 - v_8 \\ v_3 = v_6 + v_7 + v_8 \\ v_4 = -v_5 + v_6 + v_7 \end{cases}$$

$$\underline{v}_c = \underline{\underline{B}}\,\underline{v}_q \qquad \underline{\underline{B}} = \begin{pmatrix} -1 & 1 & 0 & 0 \\ 0 & -1 & 0 & -1 \\ 0 & 1 & 1 & 1 \\ -1 & 1 & 1 & 0 \end{pmatrix}$$

Si ha

$$\underline{\underline{A}} = -\underline{\underline{B}}^t$$

Esempio S1, chiuso da lungo tempo, si apre a $t=0$; S2, aperto da lungo tempo, si chiude a $t=0$. Determinare $v_C(t)$, $t \geq 0$, risposta completa.



Il circuito è criticamente smorzato per $t \geq 0$. Si ha $v_C(0^-) = 3$ V.

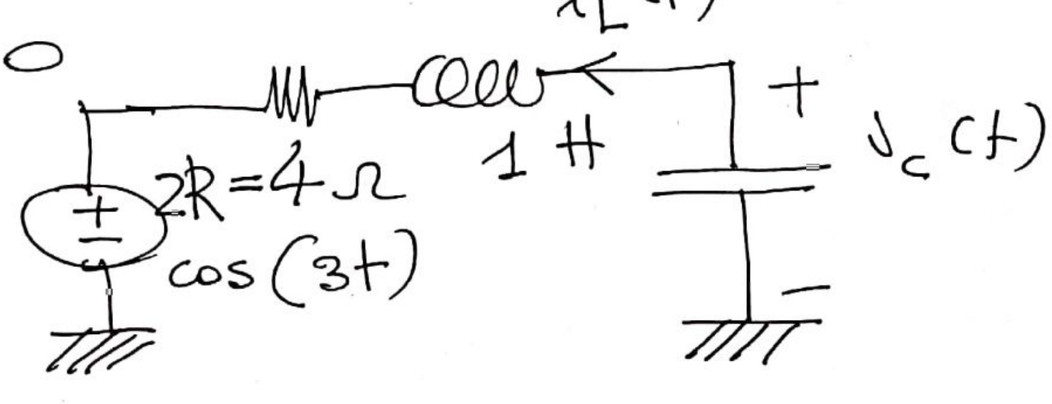
Soluzione (traccia).

$t=0^-$ regime stazionario

$i_L(0^-) = \dfrac{2}{R}$; $v_C(0^-) = 3$ V

$i_L(0^+) = \dfrac{2}{R}$; $v_C(0^+) = 3$ V.

$t > 0$



Per $t>0$ $\omega_0 = \frac{1}{\sqrt{LC}} = 2 = \alpha_s = \frac{2R}{2L} \Rightarrow$

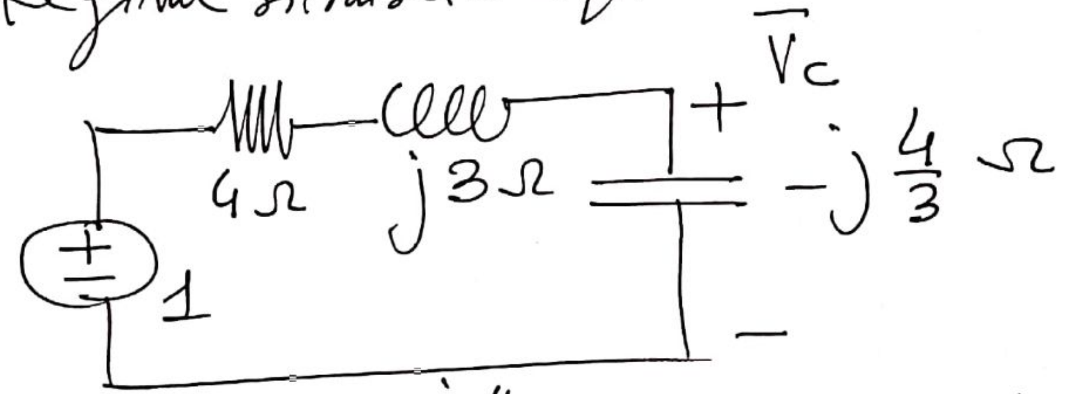
$R = 2\,\Omega$.

Si ha per $v_c(t)$

$\mathcal{C}$ = TC + Regime Sinusoidale

$$v_c(t) = k_1 e^{-2t} + k_2 t e^{-2t} + V_M \cos(3t+\varphi_v) \qquad t \geq 0$$

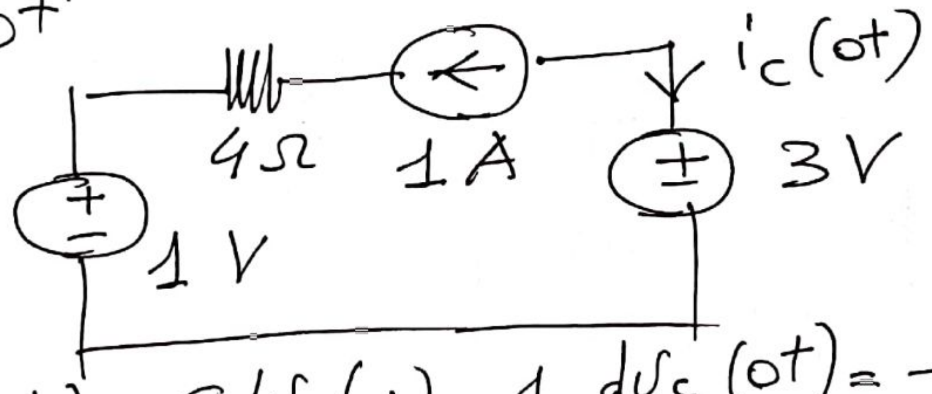
Regime sinusoidale per $t \to \infty$.



$$\bar{V}_c = 1 \cdot \frac{-j\frac{4}{3}}{4+j\left(3-\frac{4}{3}\right)} = \dots = V_M e^{j\varphi_v}$$

Condizioni iniziali per problema di Cauchy.

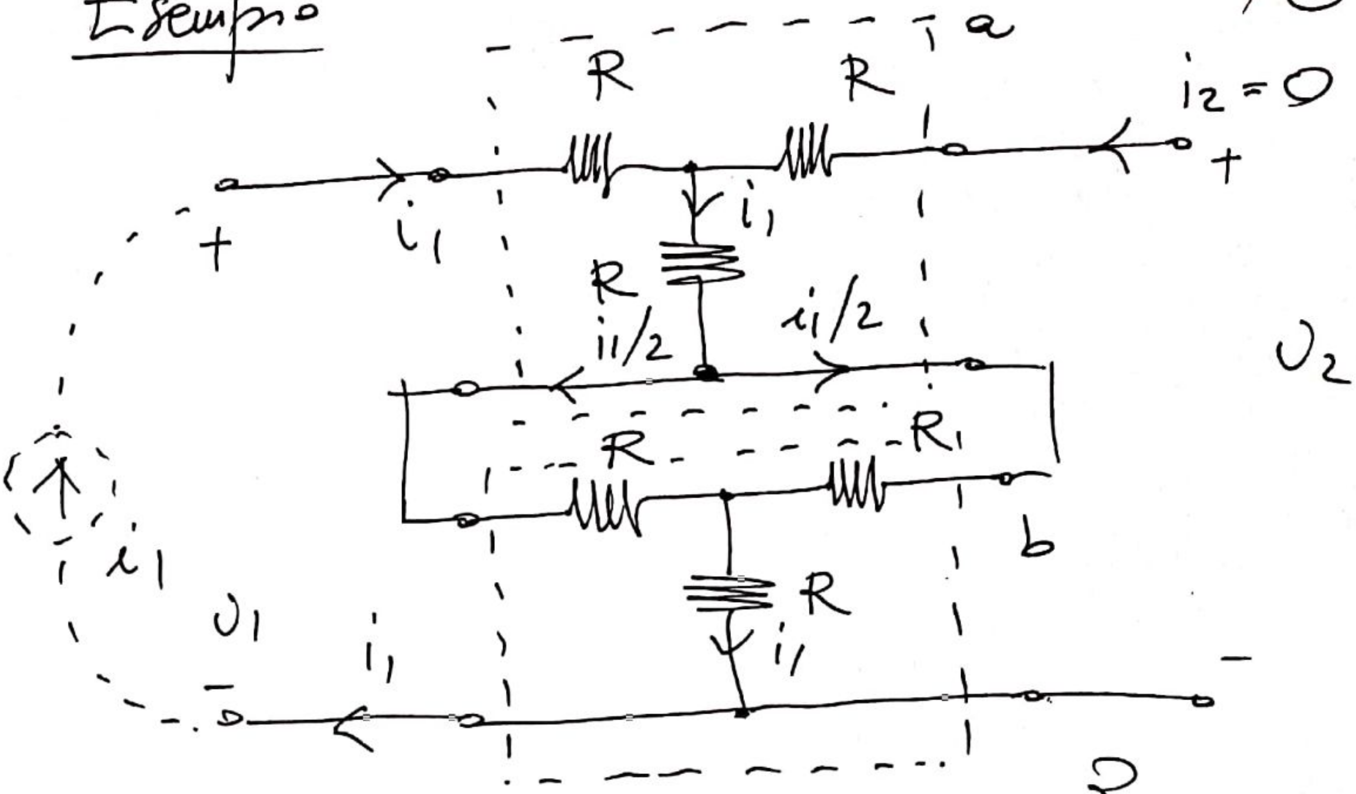
$t = 0^+$



$$i_c(0^+) = C\frac{dv_c}{dt}(0^+) = \frac{1}{4}\frac{dv_c}{dt}(0^+) = -1$$

$$\Rightarrow \frac{d}{dt}v_c(0^+) = -4 \text{ V/sec.}$$

Esempio



$$\underline{\underline{Z}}_a = \underline{\underline{Z}}_b = \begin{pmatrix} 2R & R \\ R & 2R \end{pmatrix} \overset{?}{\Rightarrow}$$

$$\underline{\underline{Z}} = \underline{\underline{Z}}_a + \underline{\underline{Z}}_b = \begin{pmatrix} 4R & 2R \\ 2R & 4R \end{pmatrix} \quad !?$$

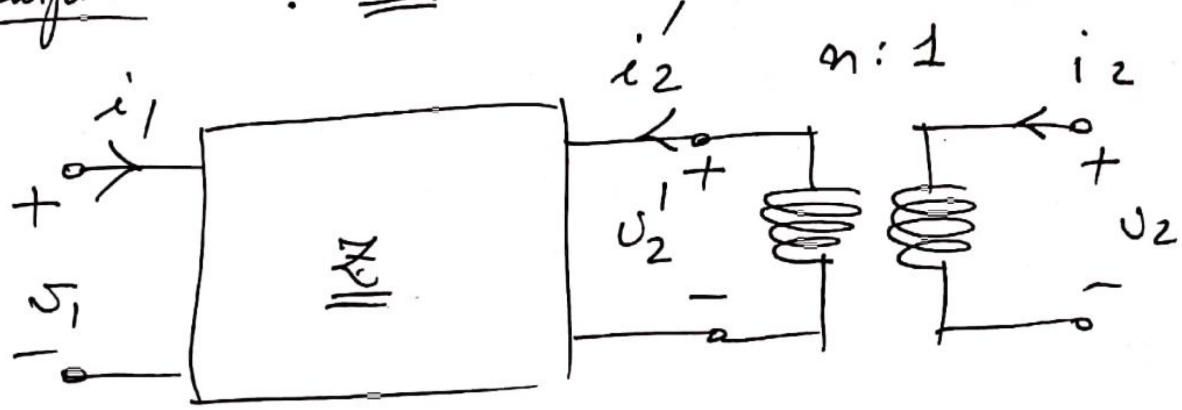
ma dalla definizione operativa

$$Z_{11} = R + R + \frac{R}{2} + R = \frac{7}{2}R \neq 4R$$

Il problema è che i due quadripoli così interconnessi non funzionano da reti due porte.

È una interconnessione serie <u>NON</u> <u>VALIDA</u>.

Esempio ? $\underline{\underline{Z}}$ ②



T ideale: $v_2' = n v_2$; $i_2' = \frac{1}{n} i_2$

È una rete due porte !

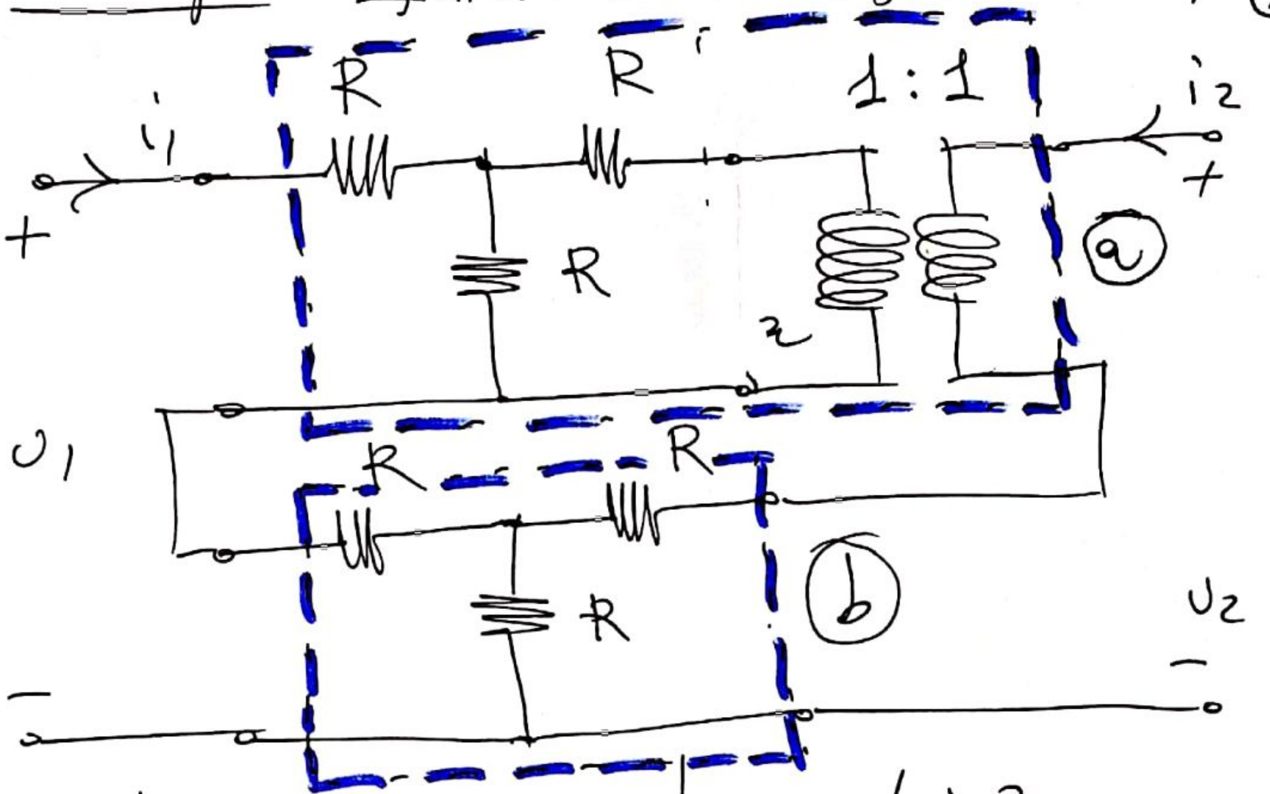
$$Z_{11} = \frac{v_1}{i_1}\Big|_{i_2=0} = \frac{v_1}{i_1}\Big|_{i_2'=0} = z_{11}$$

$$Z_{21} = \frac{v_2}{i_1}\Big|_{i_2=0} = \frac{1}{n}\frac{v_2'}{i_1}\Big|_{i_2'=0} = \frac{1}{n} z_{21}$$

Mostrare poi che

$Z_{12} = \frac{1}{n} z_{12}$; $Z_{22} = n^2 z_{22}$.

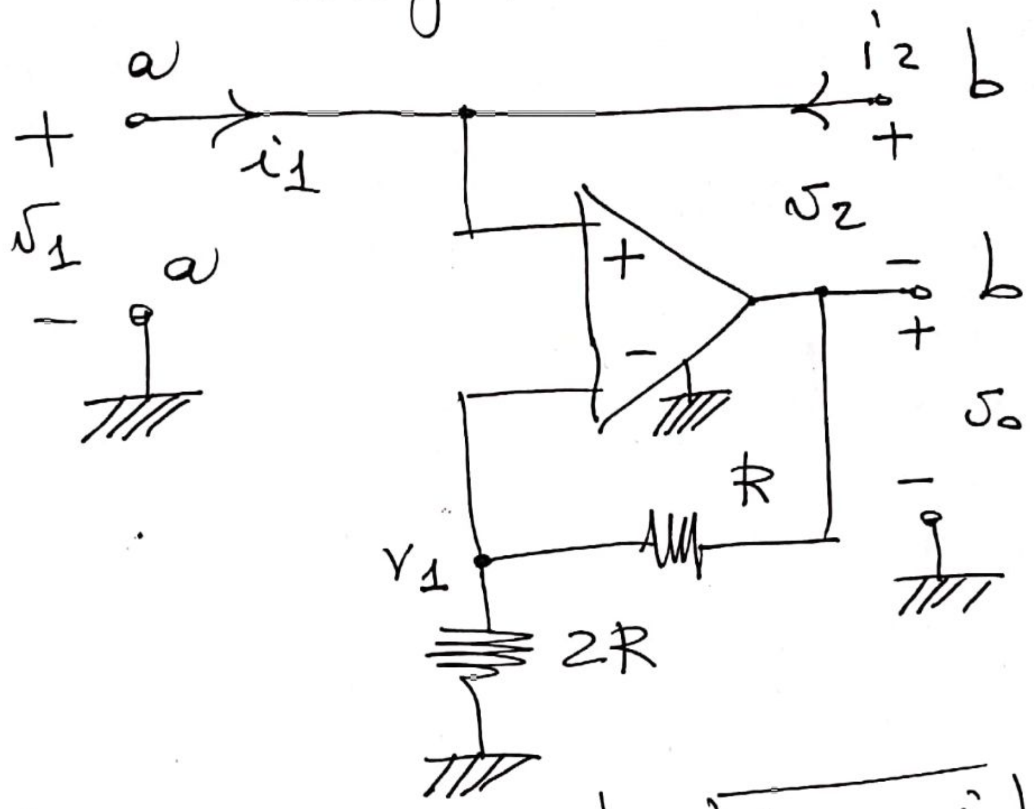
Esempio Intereconnessione serie radiale. (3)



Adesso si sommano i parametri z.
Si ha

$$\underline{\underline{Z}} = \underline{\underline{Z}}_a + \underline{\underline{Z}}_b = \begin{pmatrix} 4R & 2R \\ 2R & 4R \end{pmatrix}.$$

Esempio: ? parametri z, y, ABCD rete due porte aa-bb



Soluzione: si ha $\boxed{i_1 = -i_2} \Rightarrow$
$\nexists$ parametri z

Inoltre:

$$v_1 = \frac{2}{3} v_o \;; \quad v_1 = v_2 + v_o \Rightarrow$$

$$v_1 = v_2 + \frac{3}{2} v_1 \;; \quad -\frac{1}{2} v_1 = v_2 \Rightarrow$$

$$\boxed{v_1 = -2 v_2} \Rightarrow \nexists \text{ parametri } y$$

Esistono invece i parametri ABCD e si ha

$$\underline{\underline{T}} = \begin{pmatrix} A & B \\ C & D \end{pmatrix} = \begin{pmatrix} -2 & 0 \\ 0 & 1 \end{pmatrix}.$$