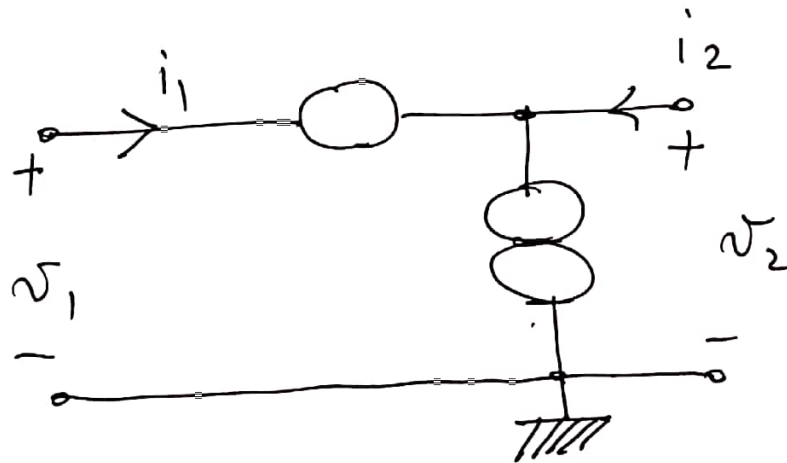
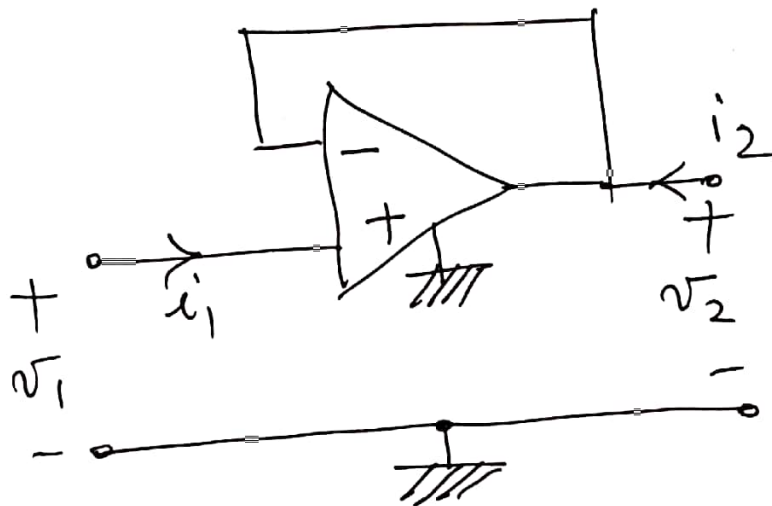
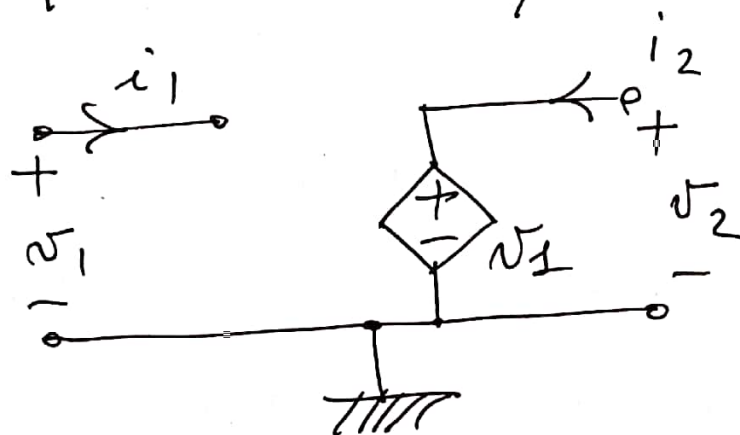


Esempio Circuito separatore (buffer) ①



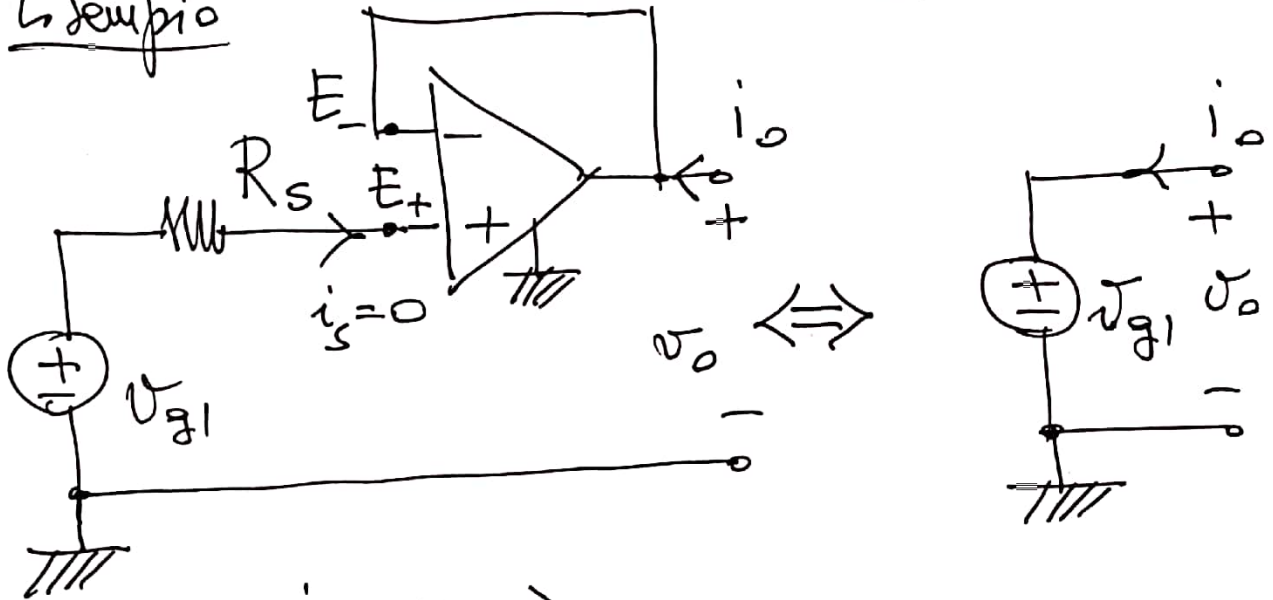
$$\begin{cases} v_2 = v_1 \\ i_1 = 0 \end{cases}$$

relazioni costitutive

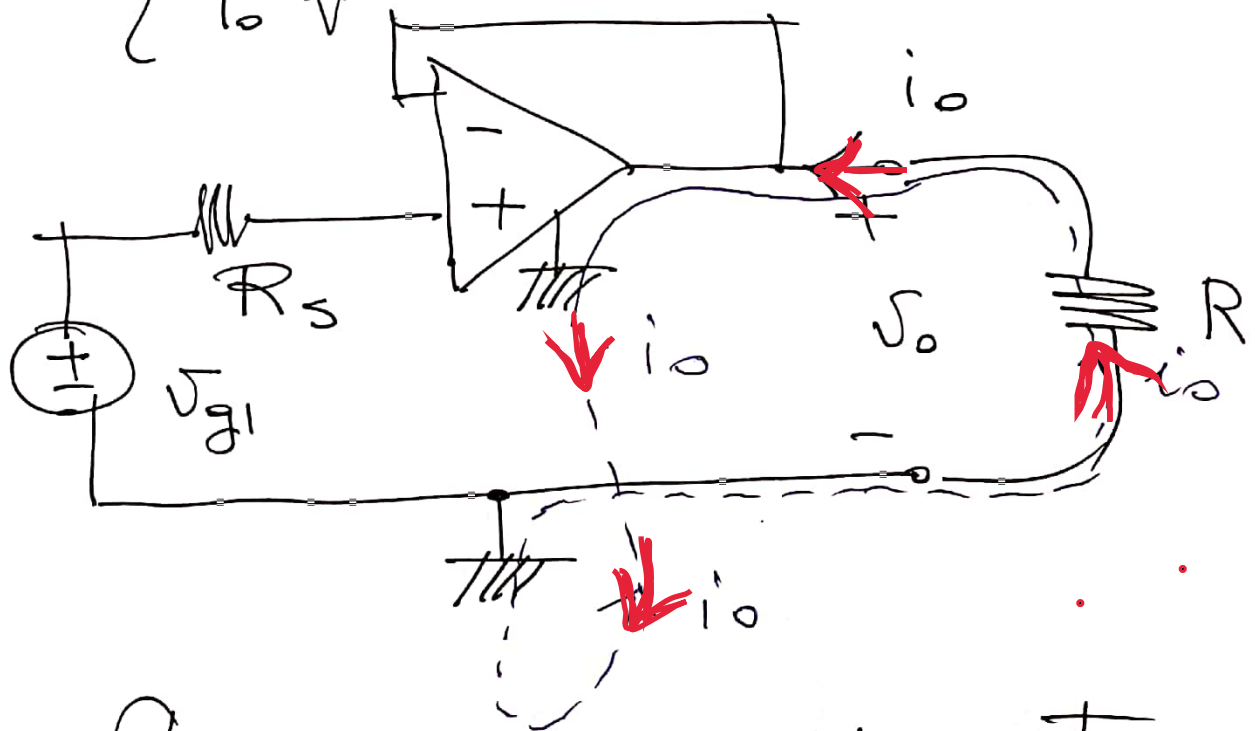


Esempio

Impiego c.to Reparatore ②

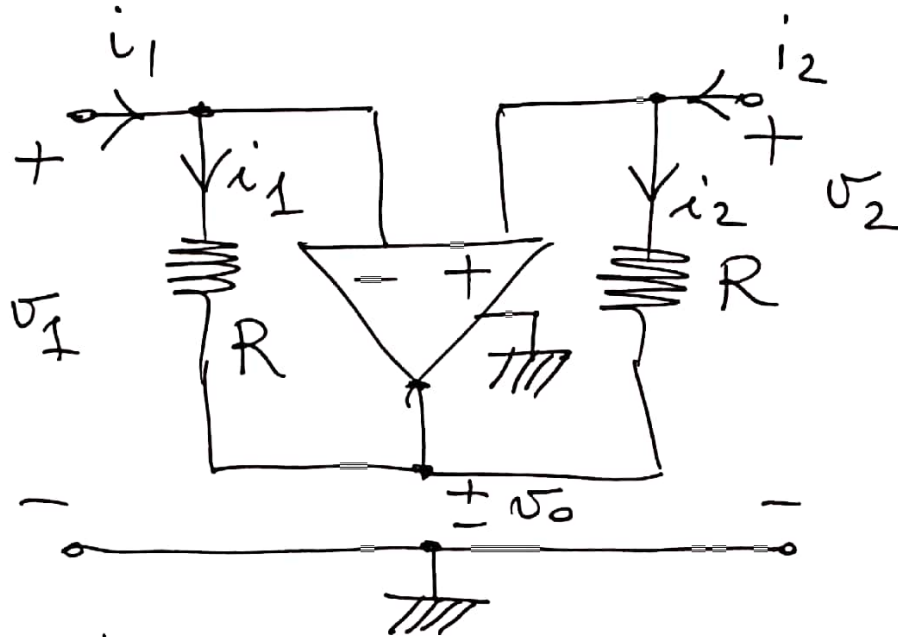


$$i_s = 0 \Rightarrow \begin{cases} V_o = E_- = E_+ = V_{g1} \\ i_o \neq 0 \end{cases}$$



Notare la circolazione di corrente nel circuito.

Invertitore di corrente ($I-\sqrt{ic}$) (3)

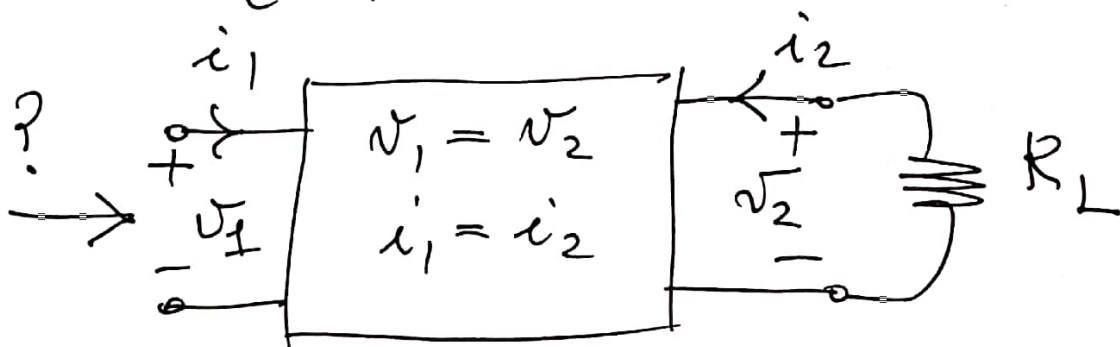


Si ha: $v_1 = v_2$

$$i_1 = \frac{v_1 - v_0}{R} ; i_2 = \frac{v_2 - v_0}{R}$$

$$\Rightarrow i_1 = i_2$$

$$\Rightarrow \begin{cases} v_1 = v_2 \\ i_1 = i_2 \end{cases} \quad \underline{I-\sqrt{ic}}$$

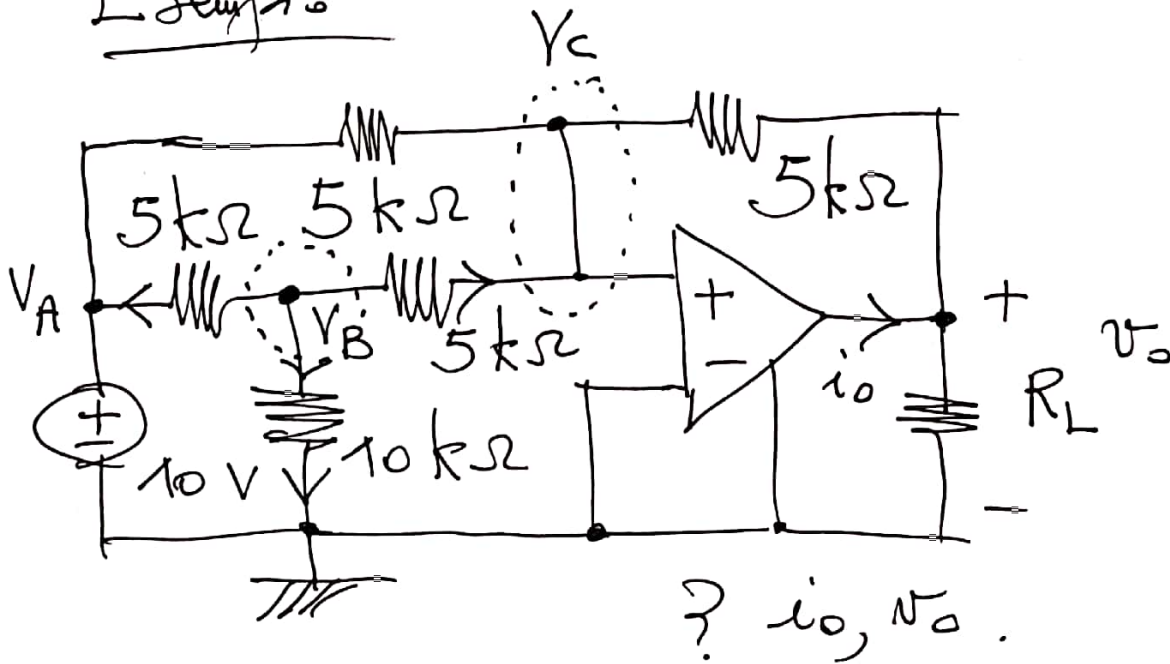


$$\frac{v_1}{i_1} = \frac{v_2}{i_2} \quad \text{ma} \quad v_2 = -R_L i_2$$

$$\Rightarrow \frac{v_1}{i_1} = -R_L \quad \dots \Leftrightarrow \quad \text{Circuit diagram showing } v_1 = -R_L i_1$$

Esercizio

(4)



4 nodi A, B, C, D;

4 incognite V_A, V_B, V_C, V_D

Ma: $V_A = 10V, V_C = 0$.

$\Rightarrow$ 2 sole incognite V_B e V_o

KI nodi B e C.

$$\textcircled{B} \quad \frac{V_B - 10}{5 \times 10^3} + \frac{V_B}{5 \times 10^3} + \frac{V_B}{10 \times 10^3} = 0$$

$$2V_B - 20 + 2V_B + V_B = 0 \Rightarrow$$

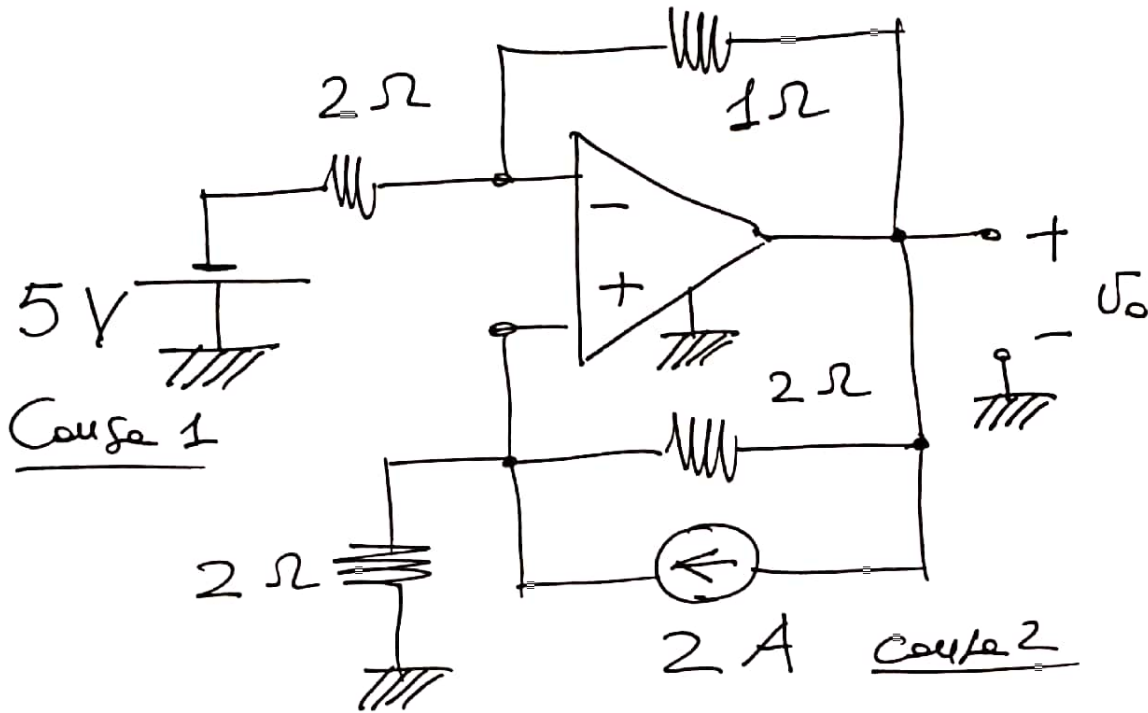
$$\boxed{V_B = 4V}$$

$$\textcircled{C} \quad \frac{10 - 0}{5 \times 10^3} + \frac{V_o - 0}{5 \times 10^3} + \frac{V_B - 0}{5 \times 10^3} + 0 = 0$$

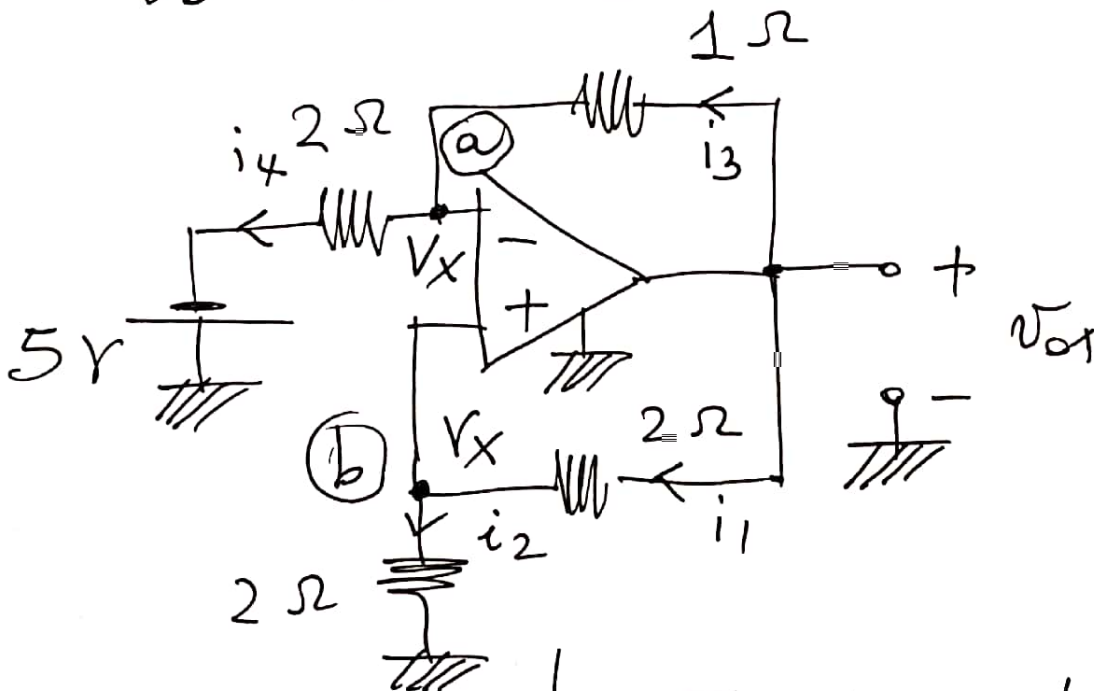
$$10 + V_o + 4 = 0$$

$$\boxed{V_o = -14V}$$

Esempio Determinare V_o usando il p.s.e. ①



$$V_o = V_{o1} + V_{o2}$$

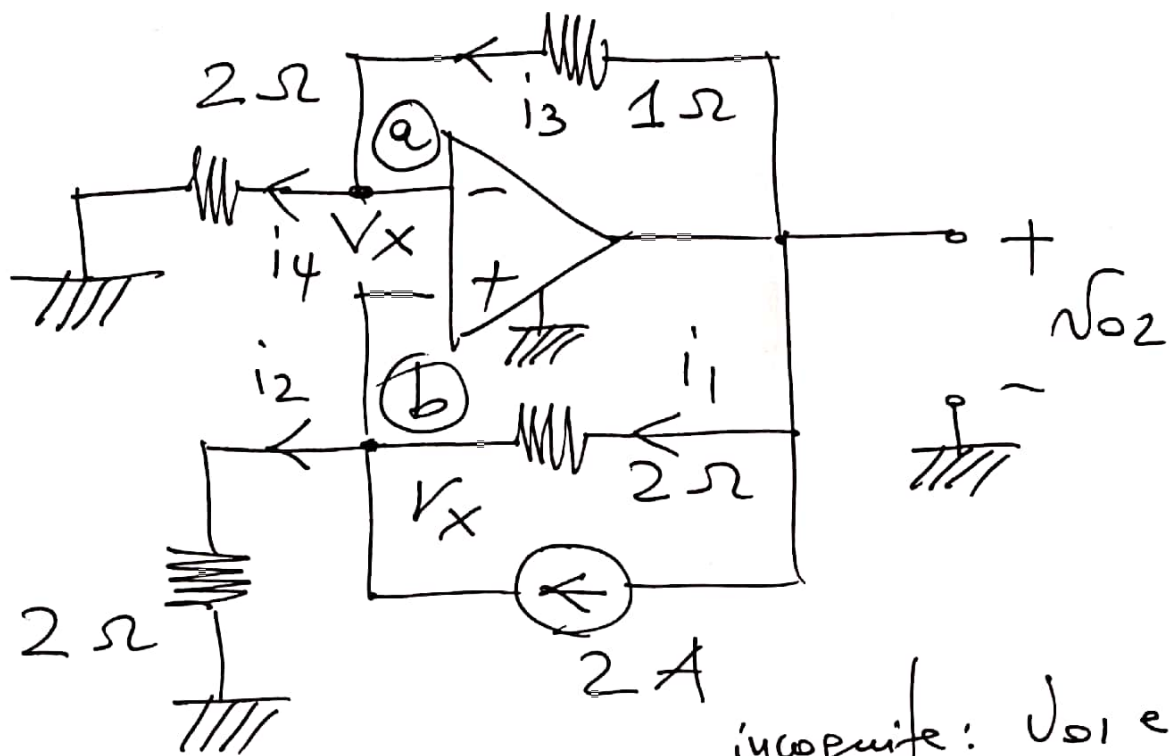


1 sola incognita V_x in equazione e V_{o1}
 KIR nodo (b): $i_1 = i_2$, cioè

$$\frac{V_{o1} - V_x}{2} = \frac{V_x - 0}{2} \Rightarrow V_x = \frac{V_{o1}}{2}$$

KIR nodo (a): $i_3 = i_4$

$$V_{o1} - \frac{V_{o1}}{2} = \left[\frac{V_{o1}}{2} + 5 \right] \frac{1}{2} \Rightarrow \boxed{V_{o1} = 10 \text{ V}}$$



incognite: V_{o1} e V_x

KI node (b): $i_1 + 2 = i_2$

$$2 + \frac{V_{o2} - V_x}{2} = \frac{V_x - 0}{2}$$

KI node (a): $i_3 = i_4$

$$\frac{V_{o2} - V_x}{1} = \frac{V_x - 0}{2}$$

risolvendo otteniamo: $V_{o2} = 12 \text{ V.}$

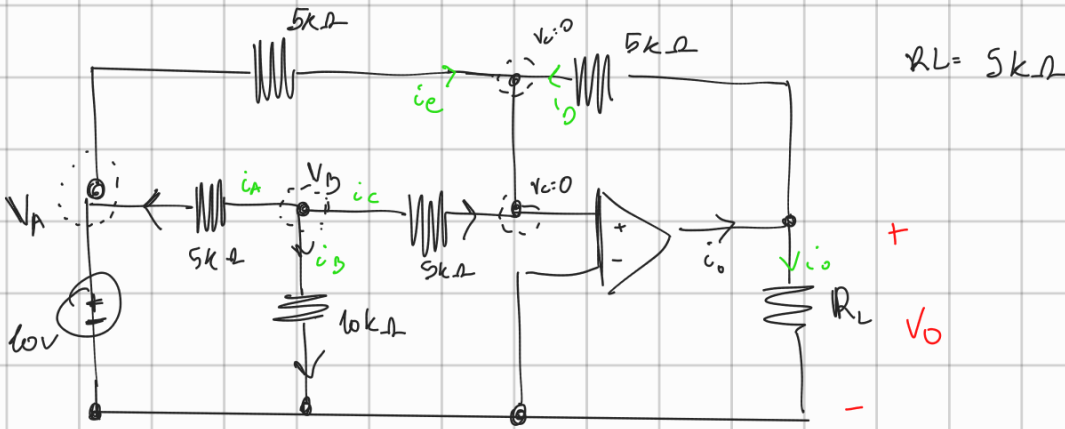
Allora

$$V_o = V_{o1} + V_{o2} = 10 + 12 = 22 \text{ V.}$$

4

Esercizio

17/04



incognite V_B e V_D

$$V_A = 10V$$

$$i_A = i_B + i_C$$

$$\frac{V_A - V_B}{5k\Omega} = \frac{V_B}{10k\Omega} + \frac{V_D - V_B}{5k\Omega} \Rightarrow V_A = V_B + \frac{3}{2} V_D$$

$$V_D = \frac{2}{3} V_A = 4V$$

$$i_C + i_D + i_E = 0$$

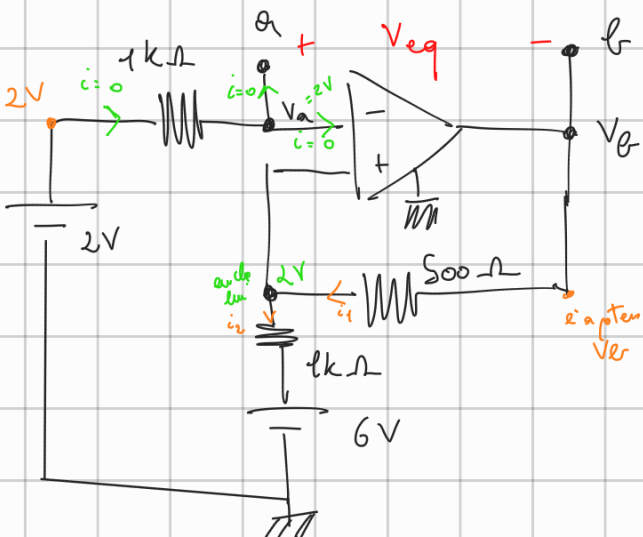
$$10 - 0$$

$$\frac{V_D - 0}{5k\Omega} + \frac{V_A}{5k\Omega} = 0$$

$$10 + V_D + 4 = 0 \quad V_D = -14V$$

$$i_D = i_A + i_B = \frac{V_D}{5k\Omega} + \frac{V_D}{5k\Omega} = -\frac{28}{5} A$$

Esercizio ? Eq. di Thevenin bipolo a b



$$V_{eq} = V_a - V_e$$

$$V_a = 2V \text{ su } R_1 \text{ 1k}\Omega \text{ non c'è solo}$$

$$i_1 = i_2$$

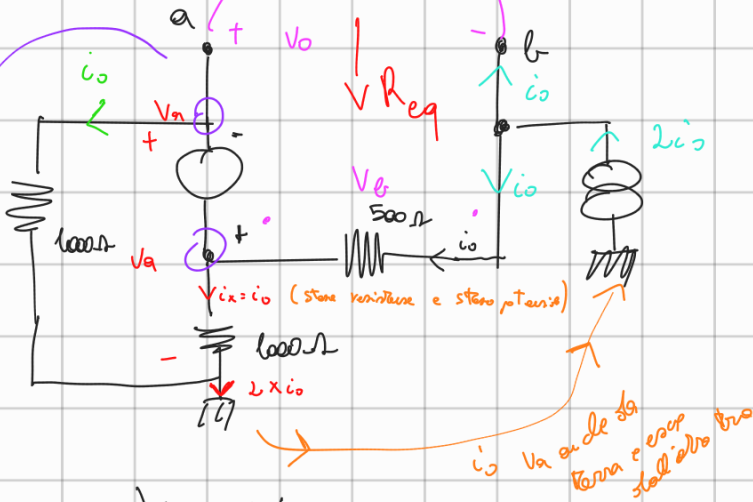
$$\frac{V_e - 2}{500} = \frac{2 - 6}{500} \Rightarrow 2V_e - 4 = -4$$

$$V_e = 0$$

$$V_{eq} = 2 - 0 = 2V$$

$R_{eq}?$

Resistenza di quando spegno le batterie, uso nullabbe per generare Def. operativa



$$R_{eq} = \frac{V_o}{i_o}$$

$$V_o = V_a - V_b$$

o scrivo 2 Kirchhoff o vedo come vedo la corrente.

scrivere Kirchhoff

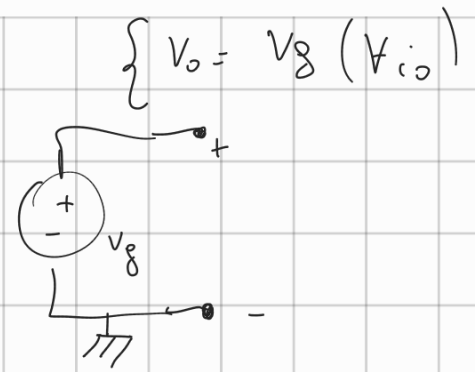
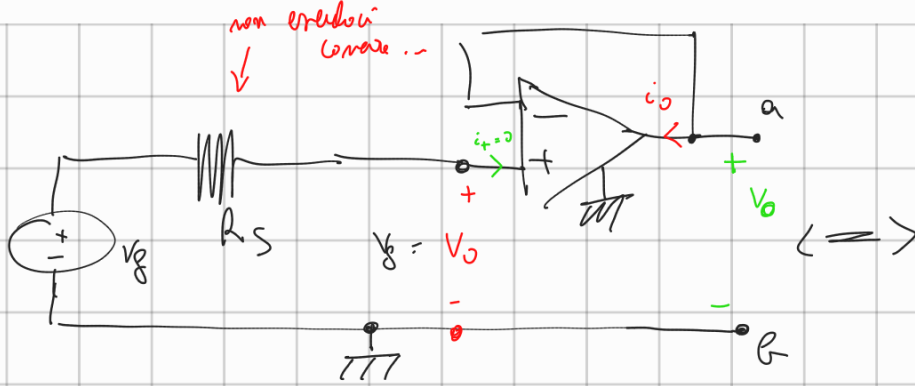
i_o non pu' passare nel nullabbe

$$V_a = 1000 i_o$$

$$i_x = \frac{1000 i_o}{1000} = i_o$$

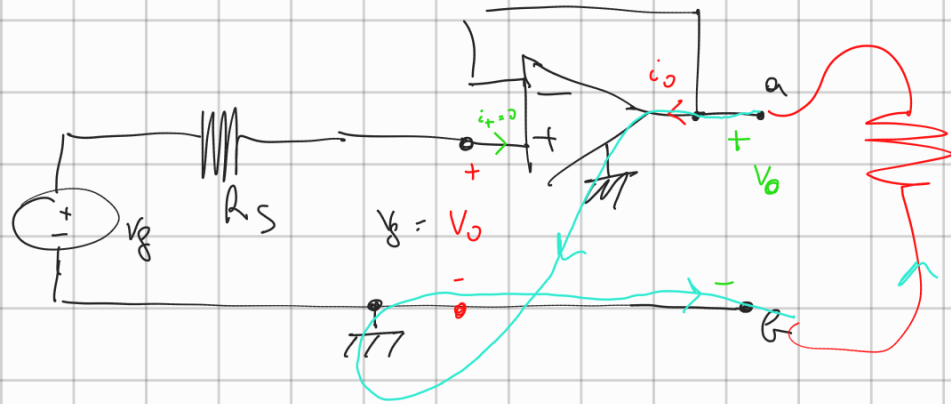
$$V_b = 500 i_o + 1000 i_o = 1500 i_o$$

$$V_o = V_a - V_b = 1000 i_o - 1500 i_o \Rightarrow V_o = -500 i_o$$



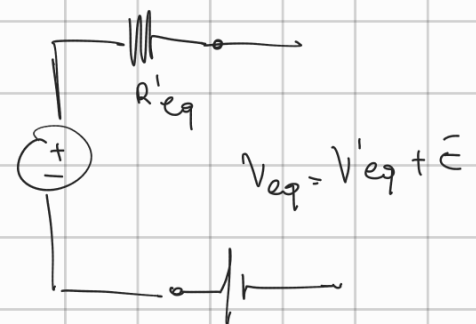
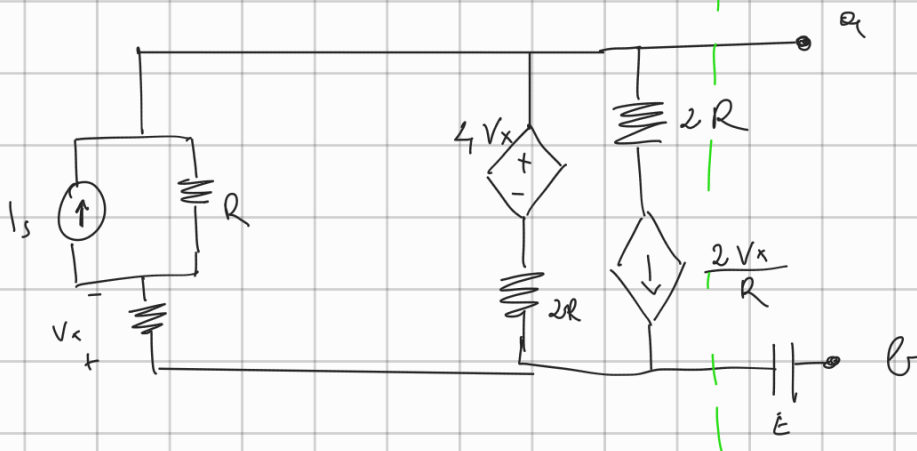
Modello classico se viene si realizza un generatore ideale

negli operazionali ci sono almeno 2 a terra, la corrente fa giri strani

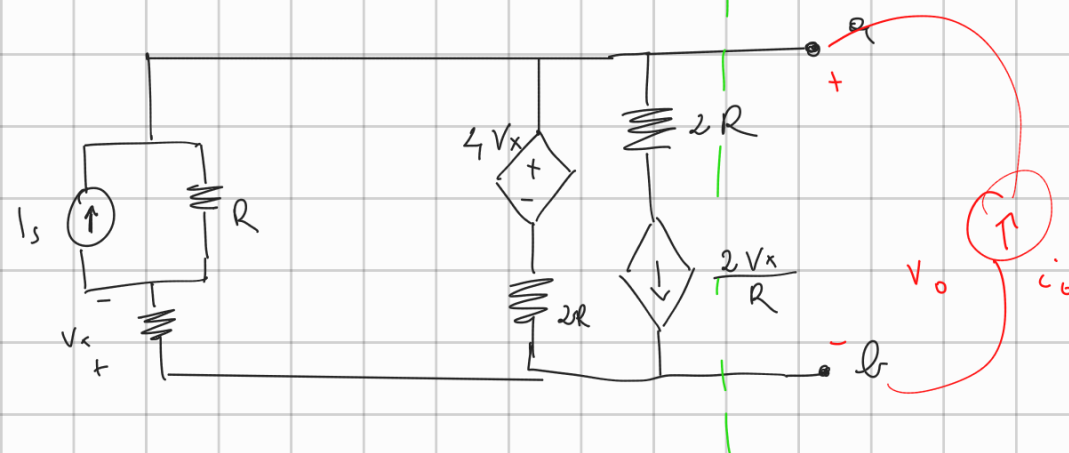


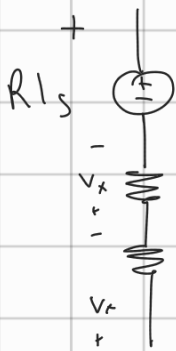
taglio

circuito equivalente

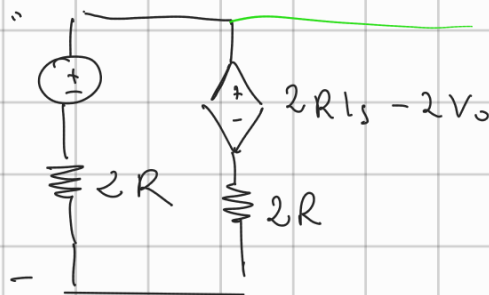


È in serie la batteria, la R equivalente e la stessa e la V di uscita



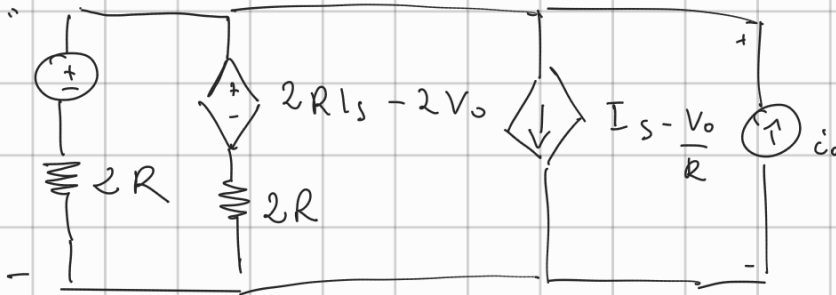


$=>$



$$V_o = R I_s - 2V_x$$

$$\Rightarrow V_x = \frac{R I_s - V_o}{2}$$

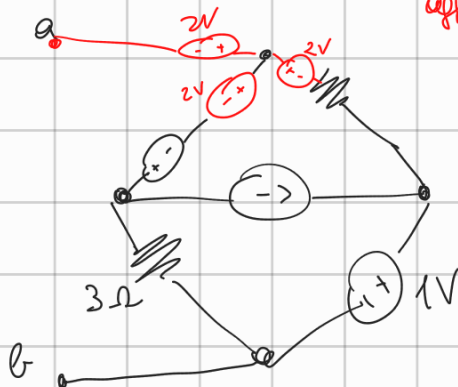


Una resistenza e' risolvibile

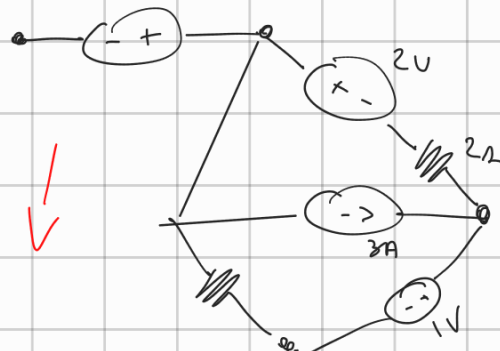
$$V_o = \frac{\frac{R I_s}{2R} + \frac{2R I_s - 2V_o}{2R} - I_s + \frac{V_o}{R} + i_o}{\frac{1}{2R} + \frac{1}{2R}}$$

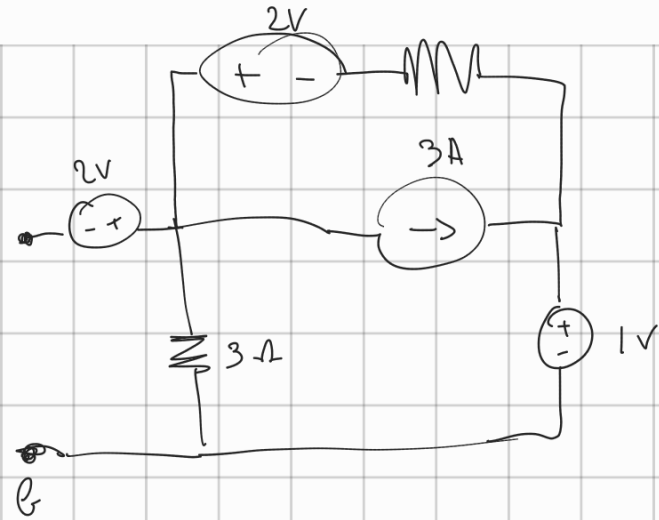
Norton Bipolo a b usando Proporzioni lineari.

aggiungo un generatore.

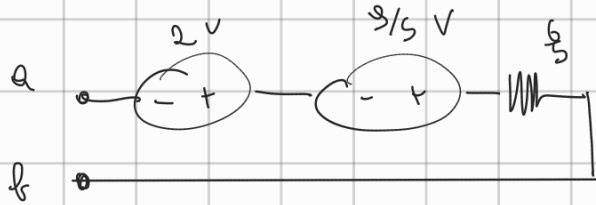
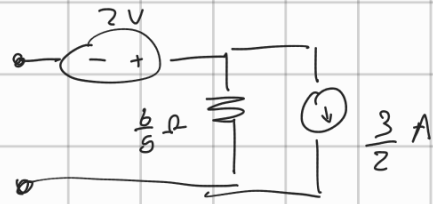
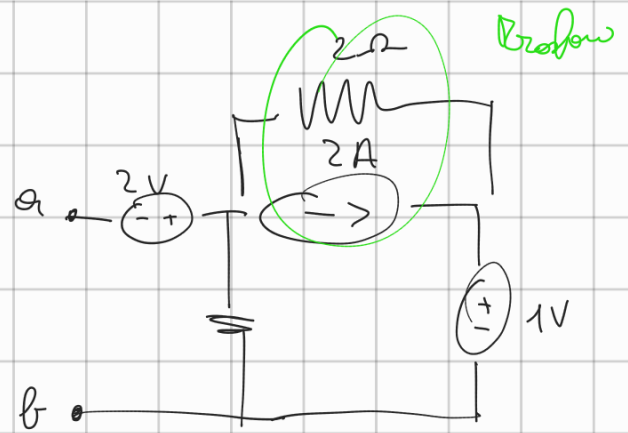


elimino il cortocircuito





$\Leftrightarrow$



Indatore co. Bresponesui
generatore di corrente.