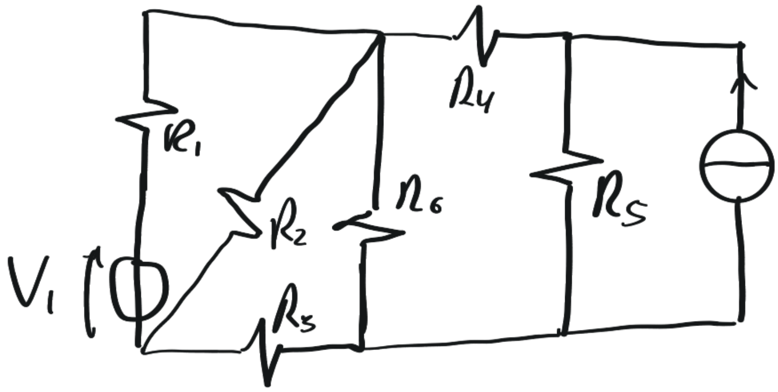
Ultima volta molto Thevenin oggi un po' Norton

Esercizio 1 → Norton

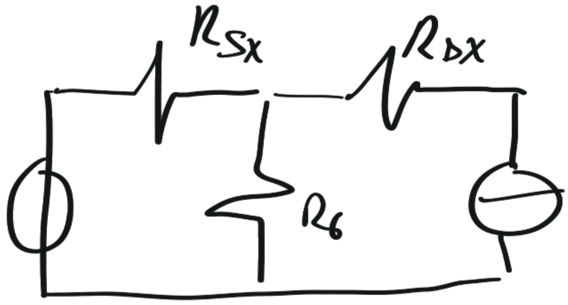


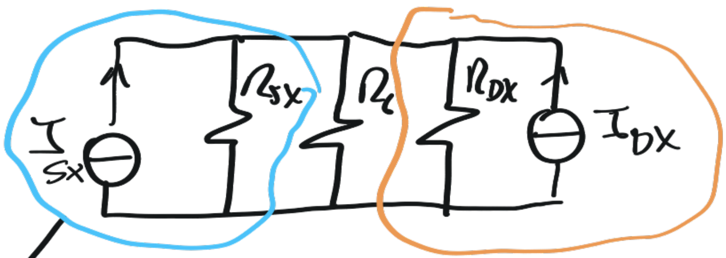
$R_1 = 4\,\Omega$
$R_2 = 15\,\Omega$
$R_3 = 5\,\Omega$
$R_4 = 100\,\Omega$
$R_5 = 25\,\Omega$
$R_6 = 8\,\Omega$

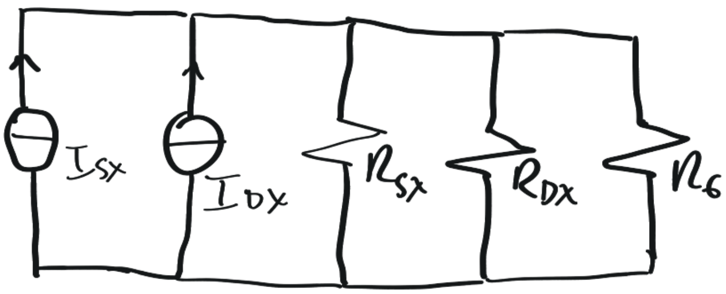
$V_1 = 25\,V$

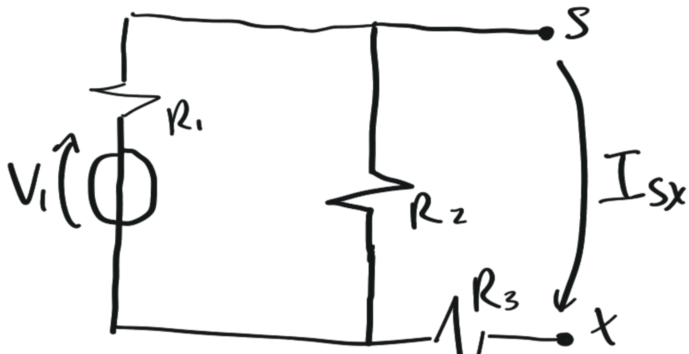
$I_S = 1\,A$

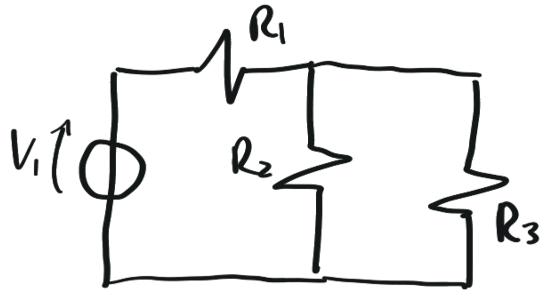
$P_{R_4} = ?$











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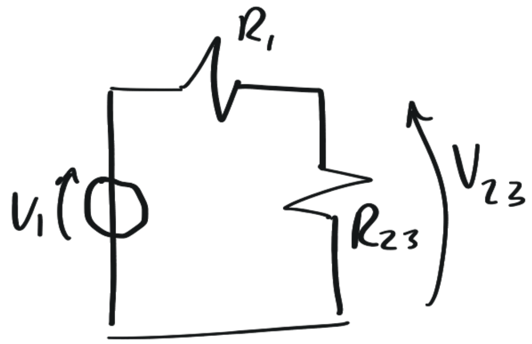
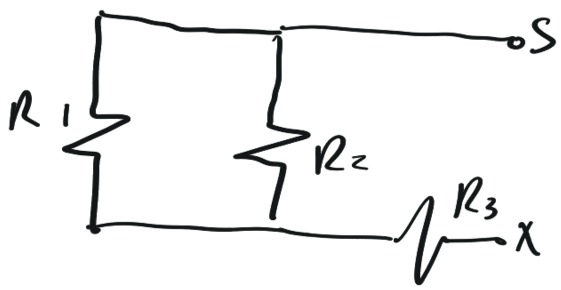


$$R_{23} = \frac{R_2 \cdot R_3}{R_2 + R_3} = 3{,}75\,\Omega$$

$$V_{23} = \frac{R_{23}}{R_2 + R_3} \cdot V_1 = 12{,}09\,V$$

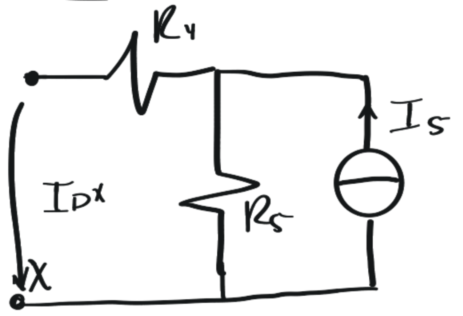
$$I_{SX} = \frac{V_{23}}{R_3} = 2{,}41\,A$$

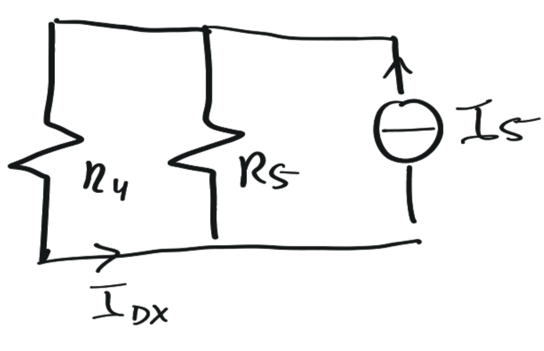


$$R_{SX} = R_3 + \frac{R_1 \cdot R_2}{R_1 + R_2} = 8{,}16\,\Omega$$

$I_{SX} = 2{,}41A$ $\qquad$ $R_{SX} = 8{,}16\,\Omega$

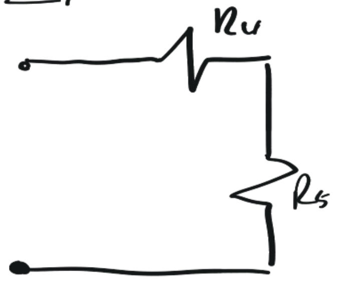
<u>Icc</u>





$$I_{DX} = \frac{R_5}{R_4 + R_5} \cdot I_5 = 0{,}71\,A$$

<u>R_{EQ}</u>

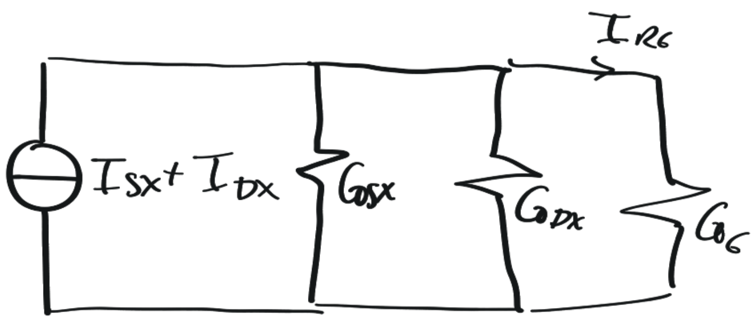


$$R_{DX} = R_4 + R_5 = 35\,\Omega$$

$$G_{SD} = \frac{1}{R_{SX}} = 0{,}123\,S$$

$$G_{DX} = \frac{1}{R_{DX}} =$$

$$G_6 = \frac{1}{R_6} = 0{,}125\,S$$

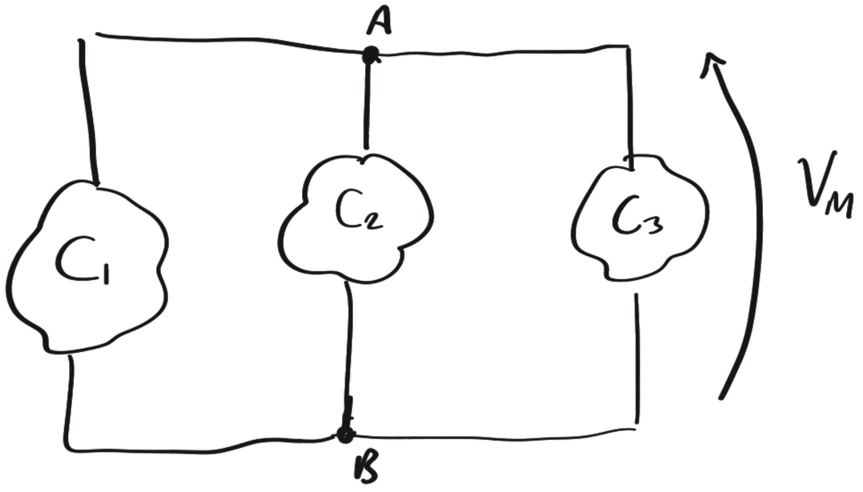


$$I_{R6} = \frac{G_6}{G_{DX} + G_{SX} + G_6} \cdot (\underbrace{I_{SX} + I_{DX}}_{3{,}12})$$

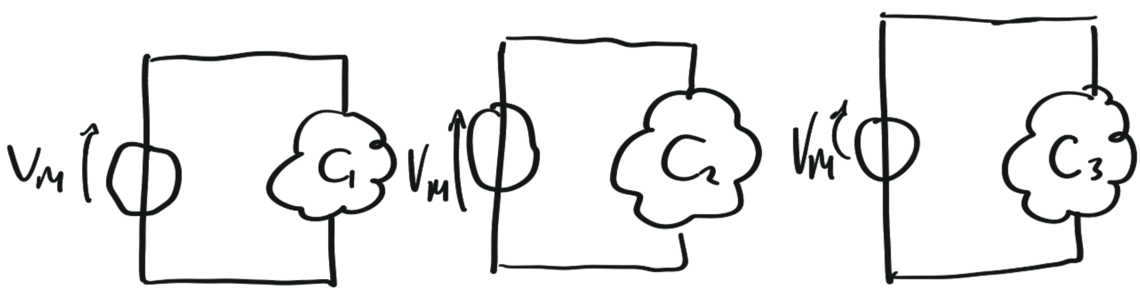
$$= 0{,}277 \cdot 3{,}12 = 0{,}77\,A$$

$$P_{R6} = R_6 I_{R6}^2 = 5{,}93\,W$$

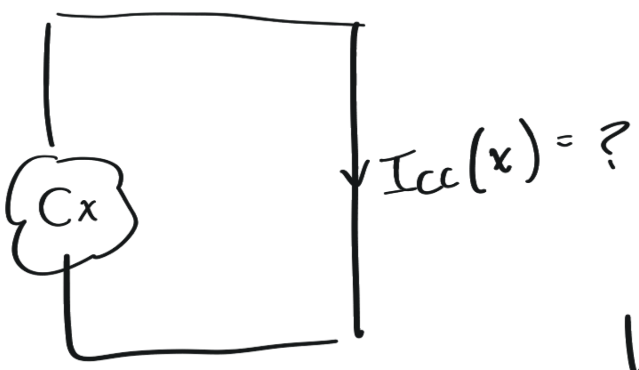
Millman

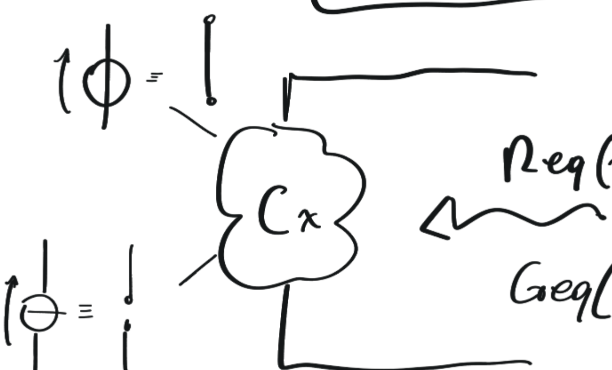


Sapendo V_M possiamo risolvere ogni porta facendo:



STEP 1)





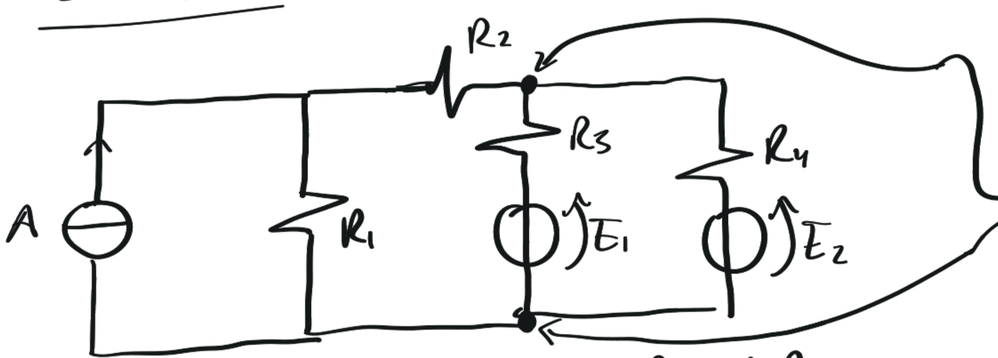
$R_{eq}(x) = ?$

$G_{eq}(x) = ?$

$$V_M = \frac{I_{cc1} + I_{cc2} + I_{cc3}}{G_{eq1} + G_{eq2} + G_{eq3}} = \frac{\sum I_{cc}(x)}{\sum G_{eq}(x)}$$

$$\sum \frac{1}{R_{eq}(x)}$$

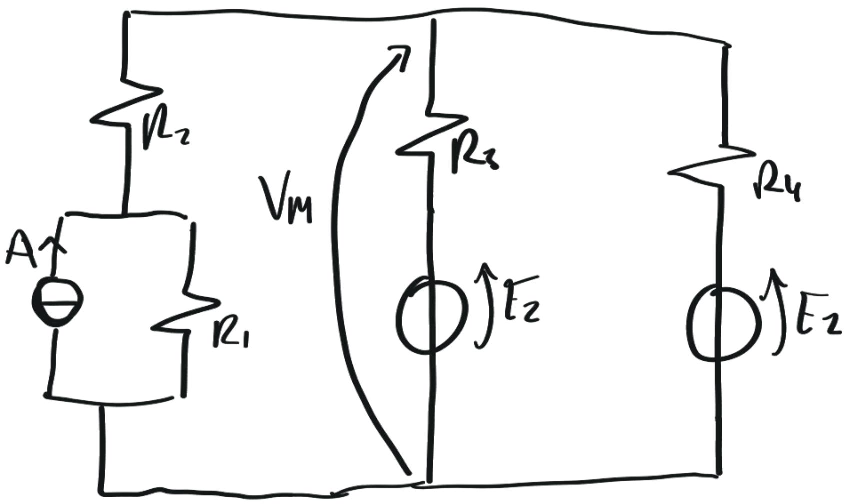
Esercizio 2



Nodi che prendiamo

$A = 5A$ $\quad R_2 = 12\Omega$ $\quad R_4 = 1\Omega$ $\quad E_2 = 3V$

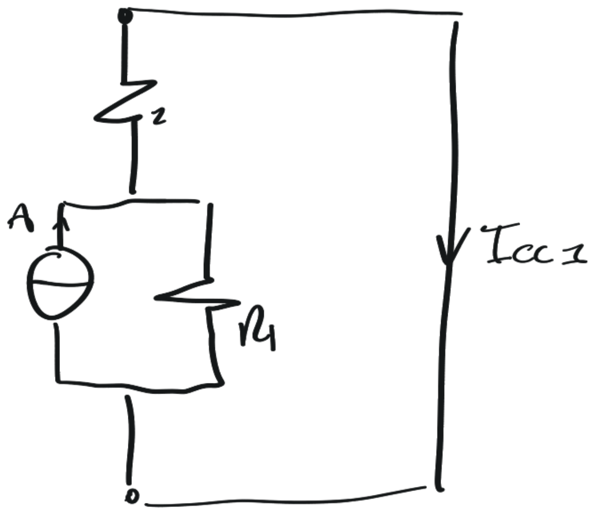
$R_1 = 4\Omega$ $\quad R_3 = 6\Omega$ $\quad E_1 = 6V$ $\quad P_{V2} = ?$

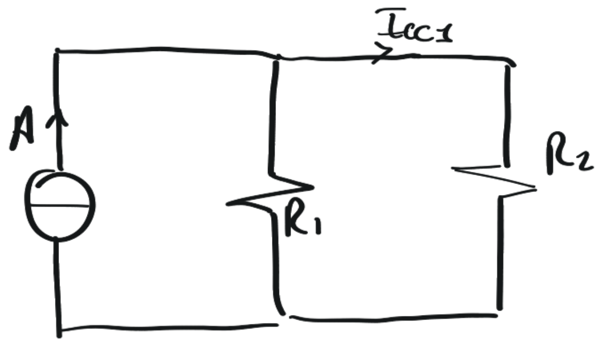


$I_{cc1} = 1,25A$

$G_{eq1} = 0,0625A$

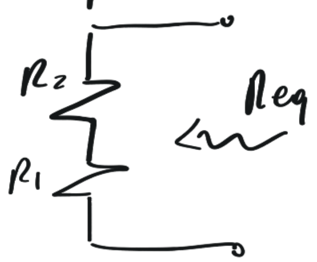
Step 1: Trovare I_{cc1}



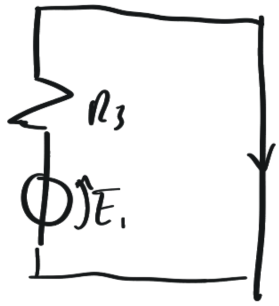


$$I_{cc1} = \frac{R_1}{R_1 + R_2} A = 1,25A$$

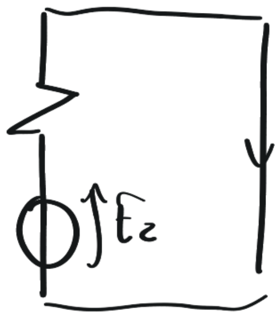
Step 2: Req



$$G_{eq1} = \frac{1}{R_1 + R_2} = 0,0625\ S$$



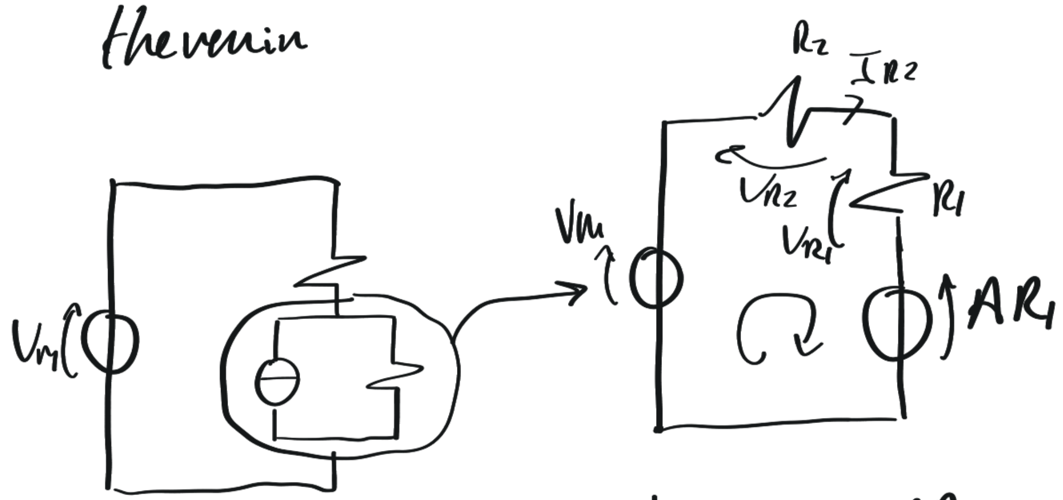
$$I_{cc2} = \frac{E_1}{R_3} = 1A \qquad G_{eq2} = \frac{1}{R_3} = 0,1\dot{6}\dot{6}S$$



$$I_{cc3} = \frac{E_2}{R_4} = 3A \qquad G_{eq3} = \frac{1}{R_4} = 1S$$

$$V_M = \frac{I_{cc1} + I_{cc2} + I_{cc3}}{G_{eq1} + G_{eq2} + G_{eq3}} = 4,27V$$

Il primo ramo potere esser semplificato con thevenin

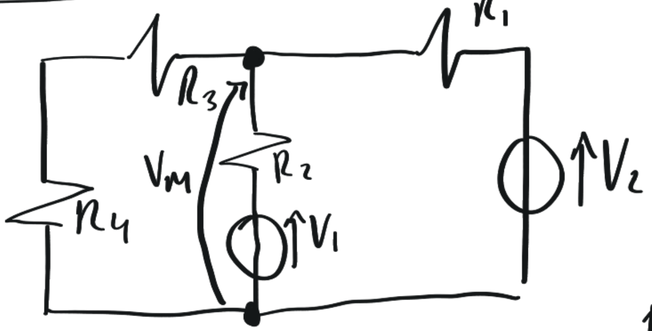


$$V_M - \underbrace{V_{R2} - V_{R1}}_{=(R_1+R_2)I_{R2}} - AR_1 = 0$$

$$I_{R2} = \frac{V_M - AR_1}{R_1 + R_2} = -0,98A$$

Iniziamo a fare i passi senza spiegarli

Esercizio 3



$R_1 = 4\,\Omega \quad R_2 = 6\,\Omega$

$R_3 = 2\,\Omega \quad R_4 = 5\,\Omega$

$V_1 = 18\,V \quad V_2 = 20\,V$

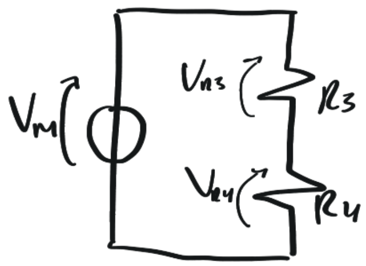
$P_{R4} = ? \quad P_{V_1} = ? \quad P_{V_2} = ?$

Ramo 1: $I_{cc1} = 0$ ma $R_{eq} = R_3 + R_4$

Ramo 2: $I_{cc2} = \frac{V_1}{R_2}$ e $R_{eq} = R_2$

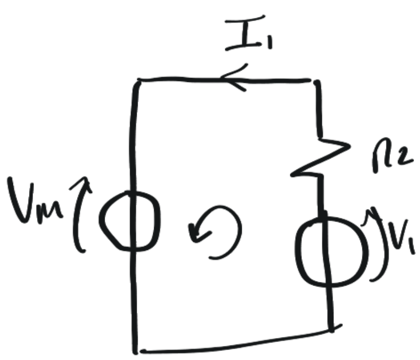
Ramo 3: $I_{cc3} = \frac{V_2}{R_1}$ e $R_{eq} = R_1$

$$V_M = \frac{0 + \frac{V_1}{R_2} + \frac{V_2}{R_1}}{\frac{1}{R_3+R_4} + \frac{1}{R_1} + \frac{1}{R_2}} = \frac{0 + 3A + 5A}{\frac{1}{7}S + \frac{1}{6}S + \frac{1}{4}S} = 14{,}298\,V$$



$$V_{R4} = \frac{R_4}{R_3 + R_4} \cdot V_M = 10{,}21\,V$$

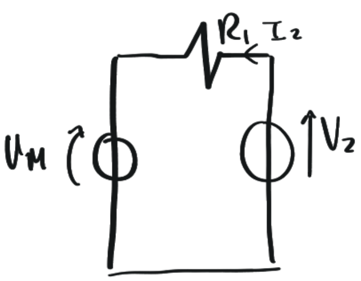
$$P_{R4} = \frac{V_{R4}^2}{R_4} = 20{,}86\,W$$



$$I_1 = \frac{V_1 - V_M}{R_2} \approx 0{,}617A$$

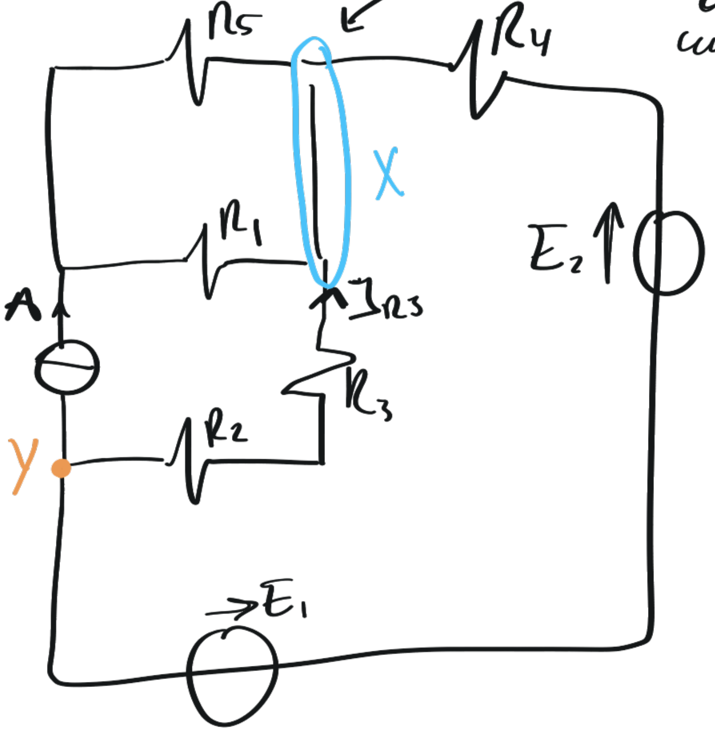
Potenziale dove corrente viene - potenziale dove corrente va, diviso per la resistenza in mezzo

$$P_{V_1} = V_1 I_1 = 6{,}85\,W$$



$$I_2 = \frac{V_2 - V_M}{R_1} = 1{,}426 \qquad P_{V_2} = V_2 I_2 = 28{,}52\,W$$

Esercizio 4



I corto circuiti di solito seguono un nodo per il circuito

$R_1 = 10\,\Omega$

$R_2 = 15\,\Omega$

$R_3 = 20\,\Omega$

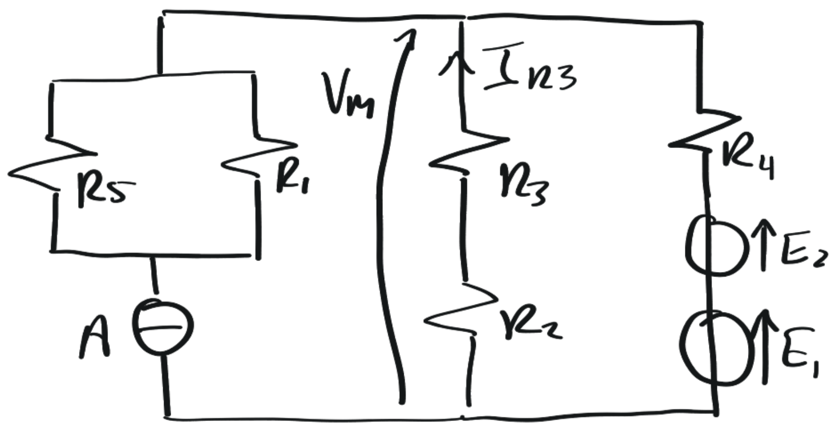
$R_4 = 6\,\Omega$

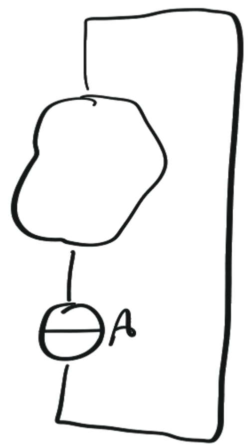
$R_5 = 5\,\Omega$

$A = 5A$

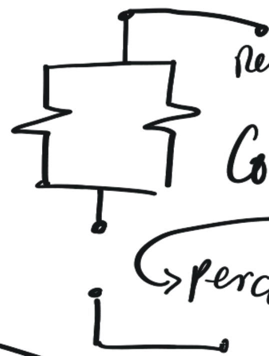
$E_1 = 25V \quad E_2 = 20V$

Rami I





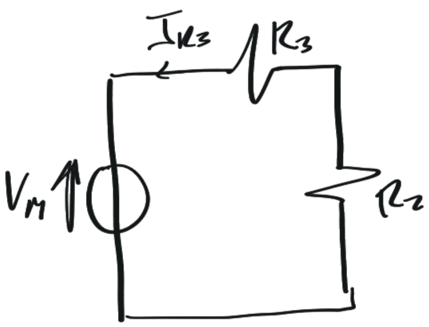
$$V_M = \frac{A + 0 + \frac{E_1 + E_2}{R}}{0 + \frac{1}{R_2 + R_3} + \frac{1}{R_4}} = 64{,}024V$$



Resistenza con I volt passante

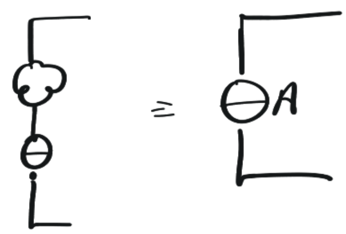
$C_{oeq} = 0$

perchè $R_{eq} = \infty$, $\frac{1}{R_{eq}} = 0$

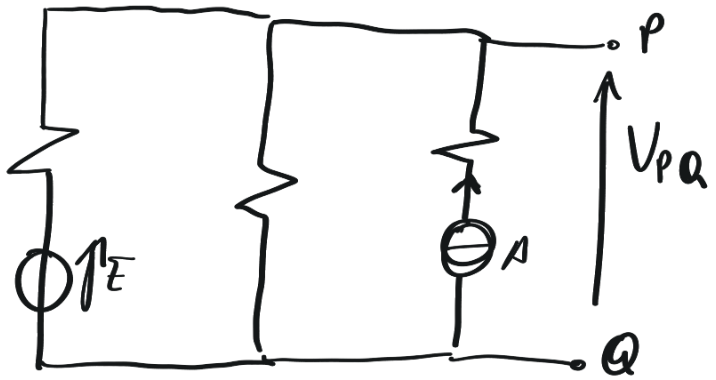


$$I_{R3} = \frac{-V_M}{R_3 + R_2} = -1{,}83A$$

Equivalente di Norton



Esercizio 5



$E = 24A$
$A = 2A$
$R_1 = 2\Omega$
$R_2 = 4\Omega$
$R_3 = 6\Omega$

Equivalente di Thevenin ai morsetti PQ

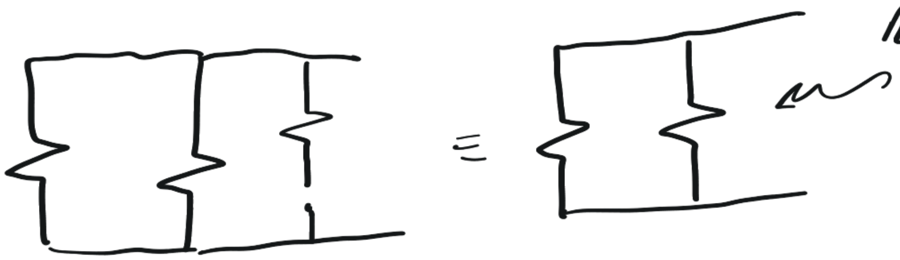
Facendo Millman troviamo Vo che è il primo ~~passo~~ di Thevenin

$$V_{PQ} = \frac{\frac{E}{R_1} + 0 + A}{\frac{1}{R_1} + \frac{1}{R_2} + 0} =$$

stesso di prima spegnendo A,
$R_{RAMO3} = \infty$
$G_{eq} = 0$

$$\tfrac{1}{2} \quad \tfrac{1}{4}$$

$$= \frac{14}{3/4} = \frac{14 \cdot 4}{3} = 18{,}667\ V$$



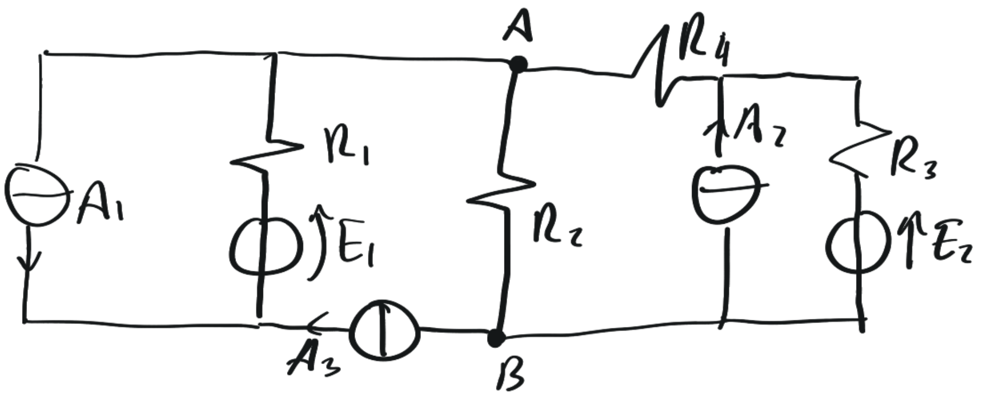
$$R_{eq} = \frac{R_1 \cdot R_2}{R_1 + R_2} = 1{,}\dot{3}\,\Omega$$

C'è una equivalenza della R_{eq} e le resistenze usate per calcolare Millman

Se fossimo stati furbi avremmo prima calcolato Req e poi fatto

$$V_{PQ} = \frac{\frac{E}{R_1} + A}{1/R_{eq}}$$

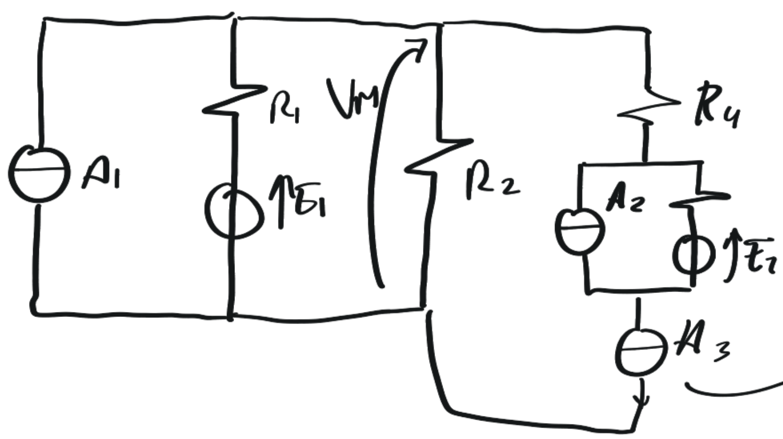
Esercizio 6



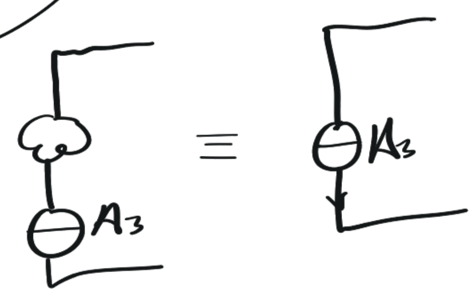
$E_1 = 40V$ $E_2 = 10V$ $A_1 = 2A$ $A_2 = 4A$ $A_3 = 8A$

$R_1 = 2\Omega$ $R_2 = 8\Omega$ $R_3 = 3\Omega$ $R_4 = 0{,}5\Omega$

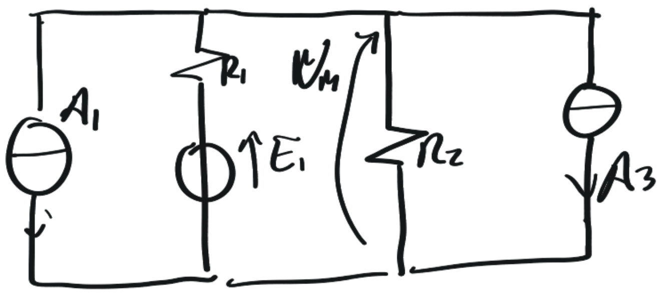
$P_{A1} = ?$ $P_{R2} = ?$ P_{R4}



Generatore in serie al circuito interno



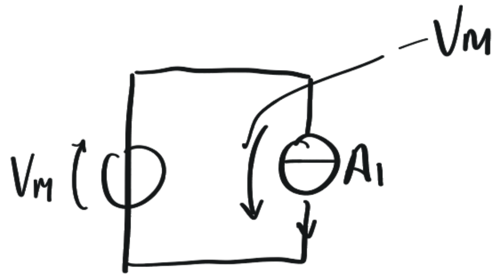
Equivalente degli effetti esterni



$$V_M = \frac{-A_1 + \frac{E_1}{R_1} + 0 - A_3}{0 + \frac{1}{R_1} + \frac{1}{R_2} + 0}$$

↳ Stesso degli ultimi due

$$= \frac{-2+20-8}{\frac{1}{2}+\frac{1}{4}} = 16V$$



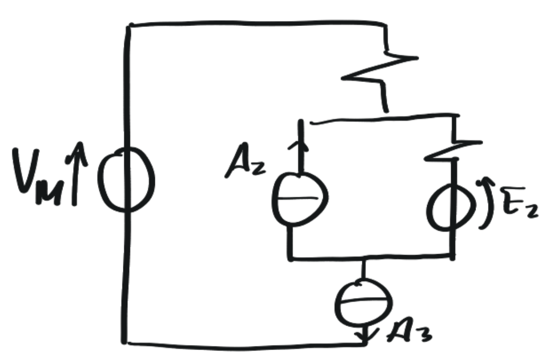
$P_{A_1} = -V_M \cdot A_1 = -32W$

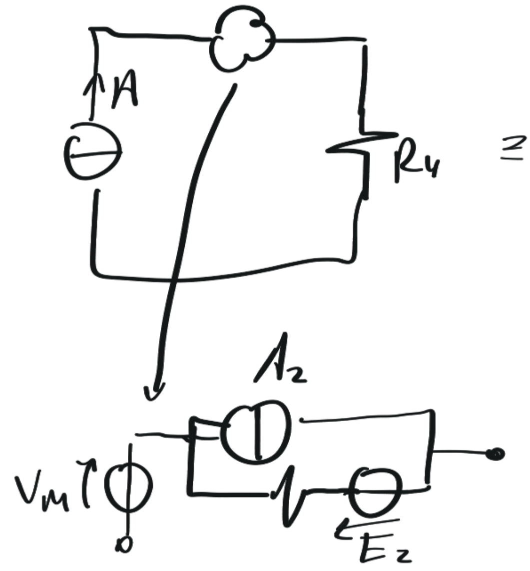
↳ Assorbendo potenza, perchè generatore che ha potenza generata negativa.

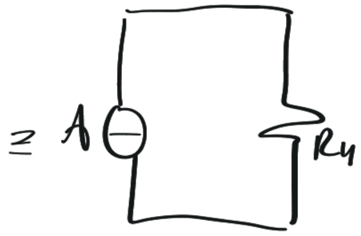
$$P_{R2} = \frac{V_M^2}{R_2} = \frac{8 \cdot 2 \cdot 8 \cdot 2}{8} = 32W$$

↳ Assorbimento, (+) perchè è un utilizzatore.

Per R_4 non possiamo usare la equivalente, dobbiamo tornare indietro e analizzare le parti interne



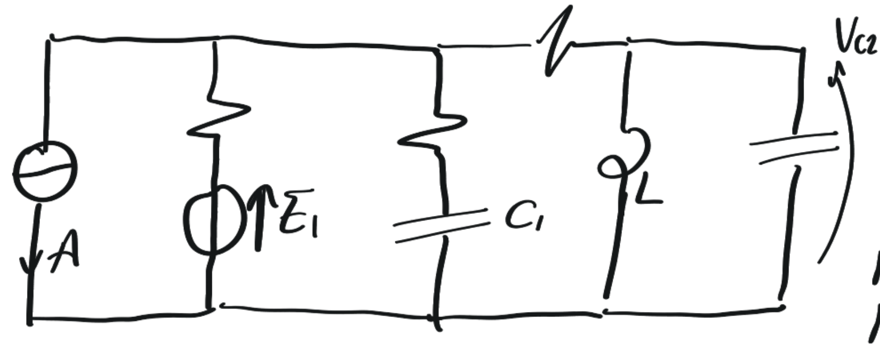




Per R_4 può passare solo A_3

$P_{R4} = R_4 A_3^2 = 32\,W$

Ultimo Esercizio

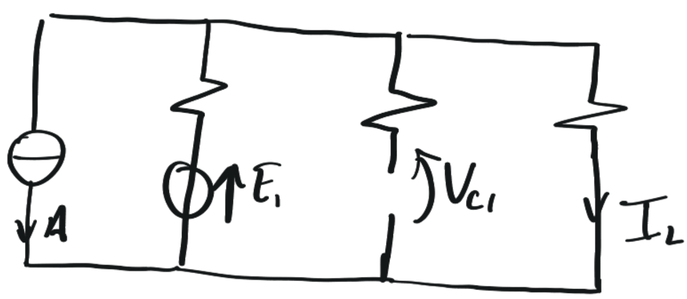


$E_1 = 18\,V$
$A = 10\,A$
$R_1 = 10\,\Omega$
$R_2 = 5\,\Omega$
$R_3 = 2\,\Omega$
$L_1 = 1\,mH$
$C_1 = 1\,\mu F$
$C_2 = 10\,\mu F$

$W_L = ?$

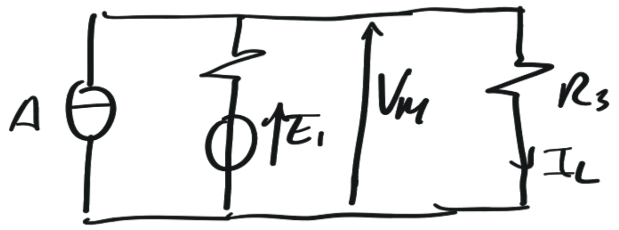
$W_{C1} = ?$

$W_{C2} = ?$



V_{C2} in corrente continua $= 0$, perchè in parallelo a $L \Rightarrow W_{C2} = 0$

$V_{C1} = V_M$, perchè dato $V_{C1} \Rightarrow V_{R3} = 0$, perchè $I_{R3} = 0$



$$V_M = \frac{-A + \frac{E_1}{R_1} + 0}{0 + \frac{1}{R_1} + \frac{1}{R_2}} = \frac{-10 + 1,8}{\frac{1}{10} + \frac{1}{2}}$$

$$= \frac{-8,2}{\frac{6}{10}} = -13,\dot{6}6\,V$$

$$W_{C1} = \frac{1}{2} C_1 V_M^2 = 46,694\,\mu J$$

$$I_L = \frac{V_M}{R_3} = -6,8\dot{3}\,A \qquad W_L = \frac{1}{2} L \cdot I_L^2 = 23,324\,mJ$$

Domanda in più

Energia assorbita a regime corrente continua

$$P_A = V_M \cdot A =$$

$$P_{E1} = E_1 \, I_{E1}$$

$$P_A + P_{E1} = P_{TOT}$$