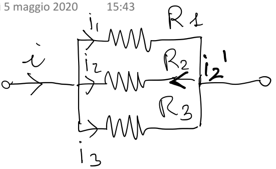
PARTITORE DI CORRENTE

martedì 5 maggio 2020 15:43

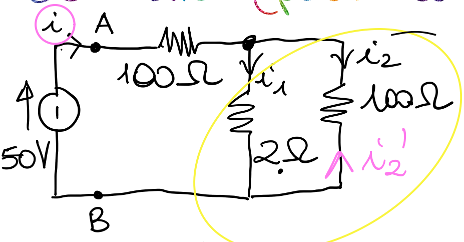

R1
i1
i
i2
R2
i2'
R3
i3

$$\begin{cases} i_1 = \frac{R_{eq}}{R_1} i = \frac{G_1}{G_{eq}} i \\ i_2 = \frac{R_{eq}}{R_2} i = \frac{G_2}{G_{eq}} i \\ i_3 = \frac{R_{eq}}{R_3} i = \frac{G_3}{G_{eq}} i \end{cases}$$

$i = i_1 + i_2 + i_3$

$$i_2' = -\frac{R_{eq}}{R_2} i = -\frac{G_{eq}}{G_2} i$$

Esercizio (part. di corrente)


i
A
100Ω
i1
i2
100Ω
1
50V
2Ω
i2'
B

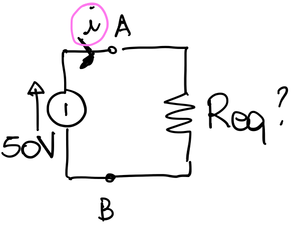
Trovare:

1) Req vista dai morsetti AB

2) i

3) i_1, i_2 con partitore di corrente

$i = i_1 + i_2$


i
A
1
50V
Req ?
B

1) $R_{eq} = 100 + \frac{2 \cdot 100}{2+100} = 100 + \frac{\cancel{200}\ 100}{\cancel{102}\ 51} =$

$= \frac{5100 + 100}{51} = \frac{5200}{51} = 101,96\ \Omega$

2) $i = \frac{50}{R_{eq}} = \frac{50}{101,96} = 0,49$ A

3)
$$\begin{cases} i_1 = \dfrac{G_1}{G'_{eq}}\, i = \dfrac{1/2}{51/100} \cdot 0{,}49 = 0{,}48\,A \\[2ex] i_2 = \dfrac{G_2}{G'_{eq}}\, i = \dfrac{1/100}{51/100} \cdot 0{,}49 = 9{,}6\,mA \end{cases}$$

Se avessimo dovuto trovare i_2'

$$i_2' = \text{\textcircled{$-$}}\, \frac{1/100}{51/100} \cdot 0{,}49$$

ATTENZIONE AI SEGNI DELLE CORRENTI !

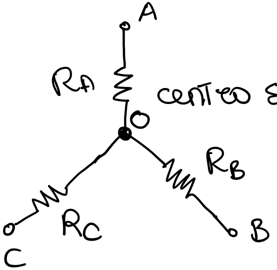
$$i_1 = \frac{G_1}{G_{eq}}\, i \qquad i_2 = \frac{G_2}{G_{eq}}\, i$$

$$i_1 + i_2 = \left(\frac{\overbrace{G_1 + G_2}^{G_{eq}}}{G_{eq}}\right) i = i$$

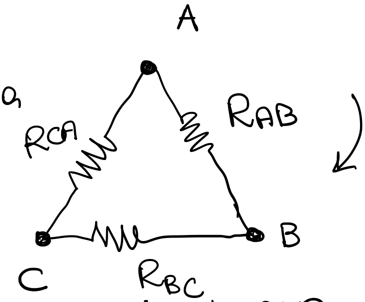
$$G'_{eq} = G_1 + G_2 = \frac{1}{2} + \frac{1}{100} = \frac{50+1}{100} = \frac{51}{100}\,S$$

$$i_1 = \frac{G_1}{G'_{eq}}\, i \qquad i_2 = \frac{G_2}{G'_{eq}}\, i$$

TRASFORMAZIONE STELLA - TRIANGOLO


A
R_A
centro stella
O
R_B
R_C
C
B

STELLA


A
R_{AB}
R_{CA}
C
B
R_{BC}

TRIANGOLO

senza alterare il regime della rete restante

$$R_A = \frac{R_{AB}\, R_{CA}}{R_{AB} + R_{BC} + R_{CA}}$$

$$R_B = \frac{R_{BC}\, R_{AB}}{R_{AB} + R_{BC} + R_{CA}}$$

$R_C =$

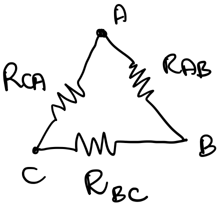
A → B → C → A

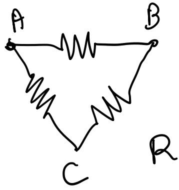
$$R_{AB} = \frac{R_A R_C + R_B R_C + R_A R_B}{R_C}$$

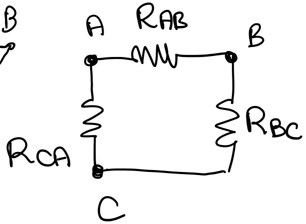
$$R_{BC} = \frac{R_A R_C + R_B R_C + R_A R_B}{R_A}$$

$\downarrow\ \downarrow$

R_{CA}

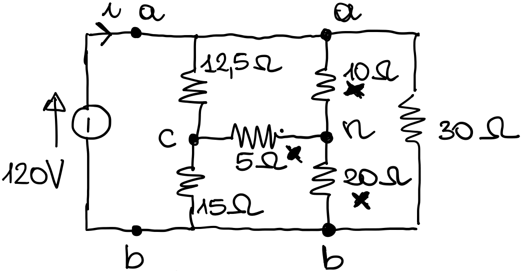

A
RCA
RAB
C
RBC
B

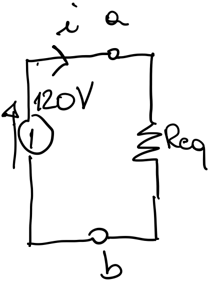


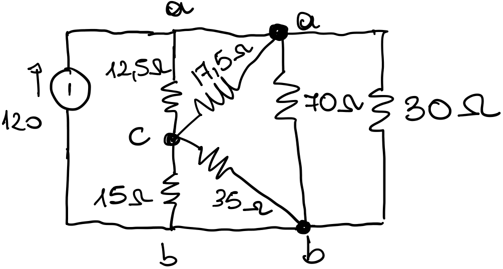

A
RAB
B
RCA
RBC
C

Esercizio: trasformazione stella triangolo

Calcolare la Req vista dai morsetti ab e la corrente i


i
a
a
12,5Ω
10Ω
30Ω
c
n
5Ω
20Ω
15Ω
120V
b
b


i
a
120V
Req
b


a
a
12,5Ω
17,5Ω
70Ω
30Ω
120
c
15Ω
35Ω
b
b

$$\begin{cases} Ra = 10\,\Omega \\ Rb = 20\,\Omega \\ Rc = 5\,\Omega \end{cases}$$

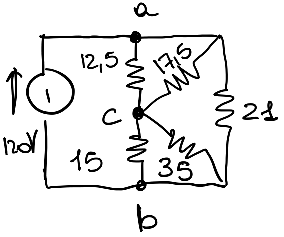
STELLA

$$Rca = \frac{RaRb + RbRc + Rca}{Rb} =$$

$$= \frac{10 \cdot 20 + 20 \cdot 5 + 5 \cdot 10}{20} = \frac{35\cancel{0}}{2\cancel{0}} = 17{,}5\,\Omega$$

$$R_{ab} = \frac{350}{R_c} = \frac{350}{5} = 70\,\Omega$$

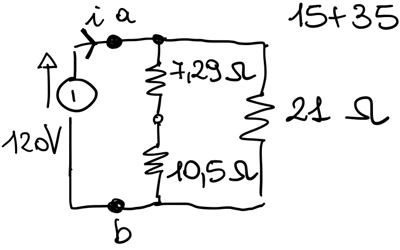
$$R_{bc} = \frac{350}{R_a} = \frac{350}{10} = 35\,\Omega$$

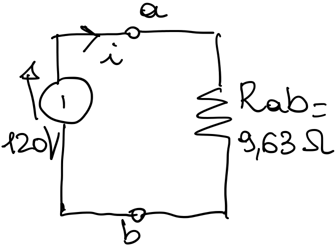

a
12,5
17,5
21
1
c
120V
15
35
b

$$70 \parallel 30 = \frac{70 \cdot 30}{70 + 30} = \frac{2100}{100} = 21\,\Omega$$

$$12{,}5 \parallel 17{,}5 = \frac{12{,}5 \cdot 17{,}5}{12{,}5 + 17{,}5} = 7{,}29\,\Omega$$

$$15 \parallel 35 = \frac{15 \cdot 35}{15 + 35} = 10{,}5\,\Omega$$


i a
7,29 Ω
1
21 Ω
120V
10,5 Ω
b


a
i
1
Rab=
9,63 Ω
120V
b

$$R_{ab} = (7{,}29 + 10{,}5) \parallel 21 = 17{,}79 \parallel 21$$

$$= \frac{17{,}79 \cdot 21}{17{,}79 + 21} = 9{,}63\,\Omega$$

$$120 = R_{ab} \cdot i \qquad i = \frac{120}{R_{ab}} = \frac{120}{9{,}63}$$

$$i = 12{,}46\,A$$

Teorema di Thevenin

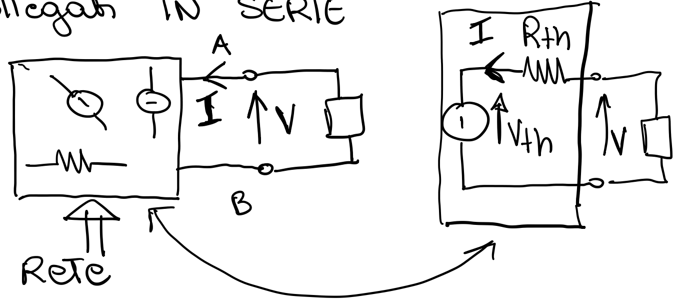
Data una rete accessibile da DUE morsetti, formata da resistori lineari e da generatori,

DAL PUNTO DI VISTA ESTERNO $\left\{ \begin{matrix} I \\ V \end{matrix} \right.$

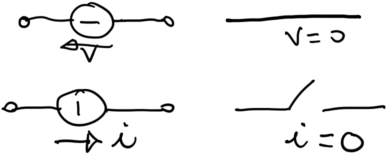
é equivalente a

- un generatore di tensione V_{th}
- un resistore di resistenza R_{th}

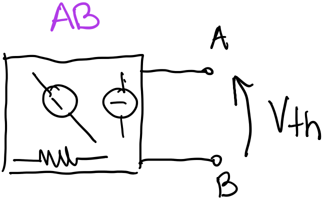
collegati IN SERIE


A
I
V
B
Rete
I
R_{th}
V_{th}
V

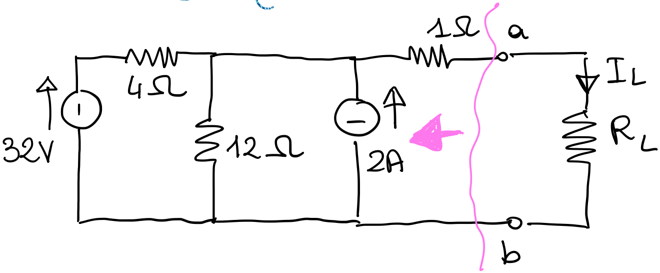
R_{th} resistenza della rete DISATTIVATA



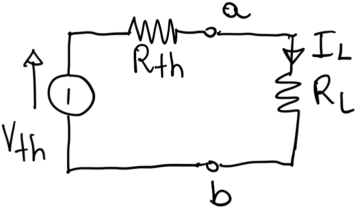
V_{th} Tensione A VUOTO ai morsetti



Esercizio (Teorema di Thevenin)

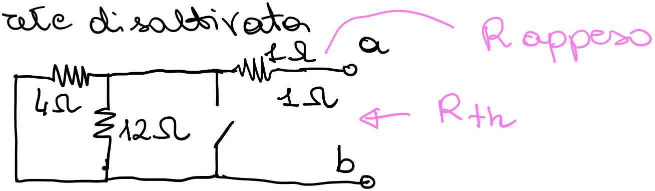

1Ω
a
4Ω
12Ω
32V
2A
I_L
R_L
b

Determinare l' equivalente di Thevenin del circuito a sinistra dei morsetti ab. Calcolare I_L per $R_L = 6 \Omega$.

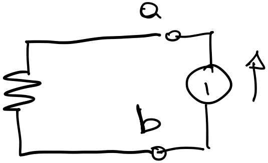

a
Rth
I_L
R_L
Vth
b

La R_{th} è la resistenza delle

rete disattivata


4Ω
12Ω
1Ω
1Ω
a
b
R appeso
Rth

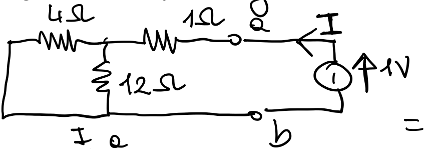
R_{eq}? $= R_{th}$



$$R_{th} = 1 + 4 /\!/ 12 = 1 + \frac{4 \cdot 12}{4+12} = 1 + \frac{48}{16} =$$

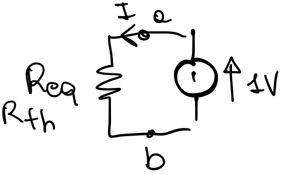
$$= \frac{16+48}{16} = \frac{64}{16} = 4\,\Omega$$

Metodo del generatore arbitrario


4Ω
1Ω
12Ω
a
b
I
1
1V

$R_{eq} =$

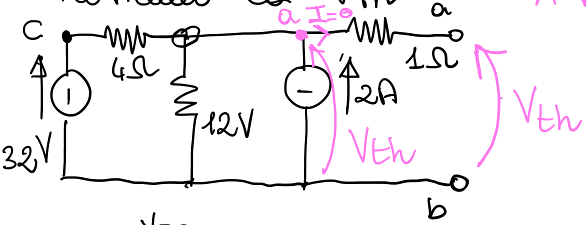
$= R_{th} = \frac{V}{I} = \frac{1}{I}$


I
a
b
Req
Rth
1V

$1 = R_{eq} I = R_{th} I$

$R_{th} = \frac{1}{I}$

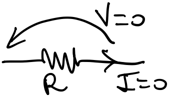
Troviamo la V_{th}


C
a I=0
a
4Ω
1Ω
12V
32V
2A
Vth
Vth
b

A VUOTO

⇓

I=0



$V = RI$

Metodo dei potenziali nodali

b nodo di riferimento

V_a, V_c

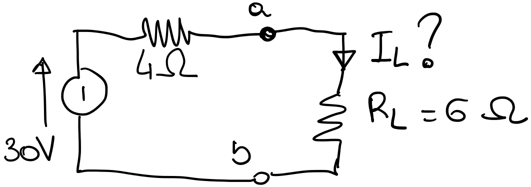
V_c é noto $\quad V_c = V_{cb} = 32V$

$V_{th} = V_{ab} = V_a$

nodo ⓐ $\rightarrow V_a\left(\frac{1}{4}+\frac{1}{12}\right) - V_b\cdot 0 - \overset{32}{\uparrow}V_c\cdot\frac{1}{4} = 2$

$V_a\frac{3+1}{12} - 8 = 2 \qquad \frac{V_a}{3} = 10 \qquad V_a = 30V$

$V_{th} = V_a = 30V$


a
4Ω
30V
I_L?
R_L = 6Ω
b

$$I_L = \frac{30}{4+6} = \frac{30}{10} = 3A$$

R_{eq} di una rete
(DISATTIVATA)

Tensione a vuoto