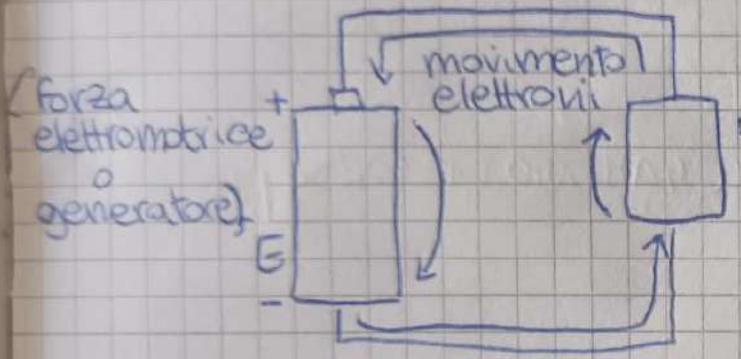
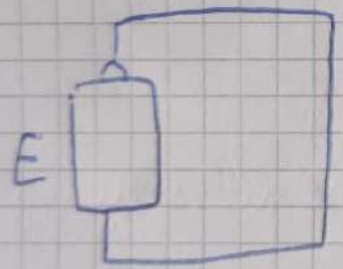
# CIRCUITO ELETTRICO ELEMENTARE




↳ trasforma l'energia elettrica




la resistenza presente è solo quella del filo (qualche Ω)

$$I = \frac{E}{R}$$

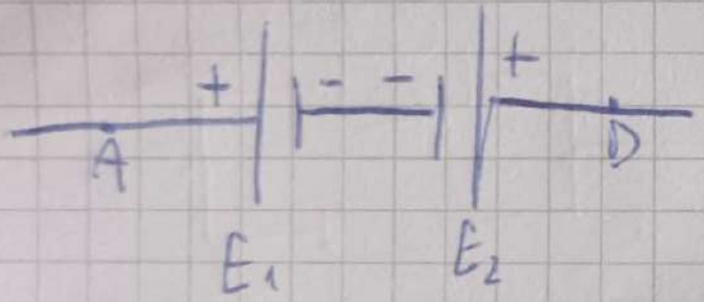
⇓ corrente elettrica

corto circuito → perché la resistenza è molto piccola (o assente) per cui la corrente aumenta quindi il filo si riscalda e va a fuoco

TEORIA X LABORATORIO

ntrollami

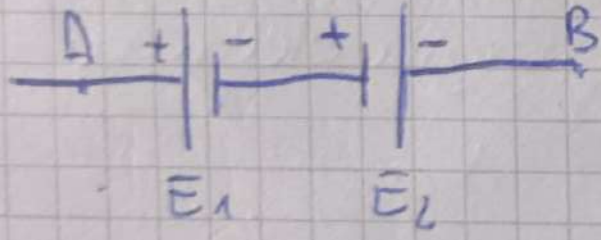
# CIRCUITI IN PARALLELO




$V_{AD} = V_{AB} + V_{CD}$

$= E_1 - E_2$

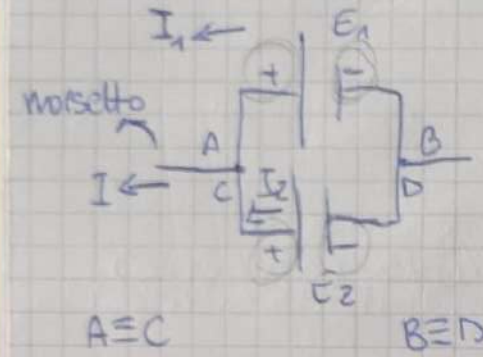
↑ non ha senso perché perdo potenza → COLLEGAMENTO DISCORDE




$V_{AB} = E_1 + E_2$

↑ COLLEGAMENTO CONCORDE

## COLLEGAMENTO IN PARALLELO



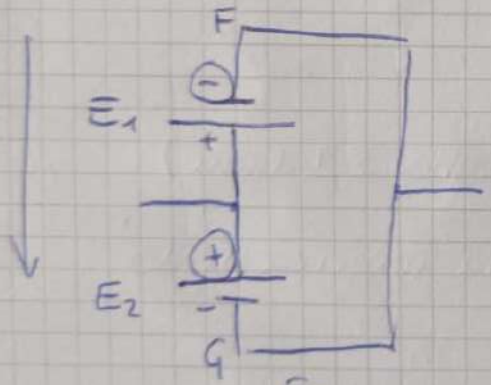

$A \equiv C$ $B \equiv D$

sono in parallelo se hanno i 2 morsetti in comune

$I = I_1 + I_2$

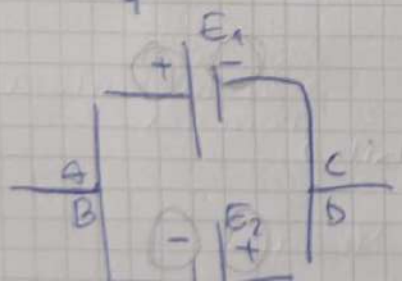
serve per aumentare la corrente massima erogabile

il collegamento è possibile solo se i 2 generatori hanno la stessa tensione $E_1 = E_2$
altrimenti si crea un corto circuito




$V_{FG} = -E_1 + E_2$

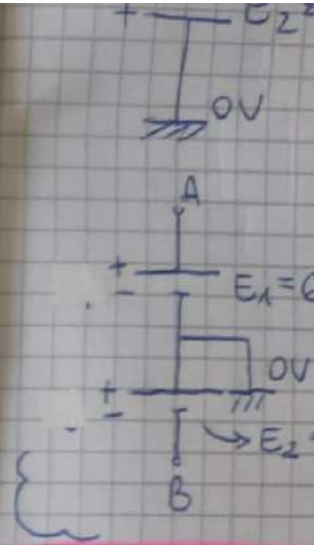
Se $E_1 \neq E_2$, $V_{FG} \neq 0$




NO! CORTOCIRCUITO.

$V_{AB} \neq V_{CD}$

$E_1 \neq -E_2$




## RESISTENZE IN


Sono in serie
morsetto non

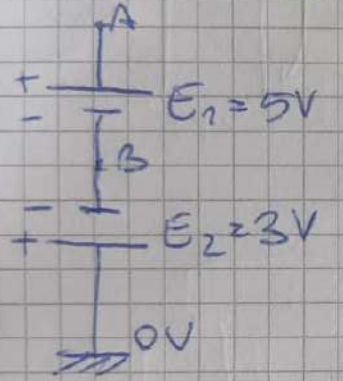

Le resistenze in
equivalente.

In tutti i circuiti elettrici c'è un riferimento di tensione che è a tensione zero

il riferimento è la Terra (conduttore collegato a terra)

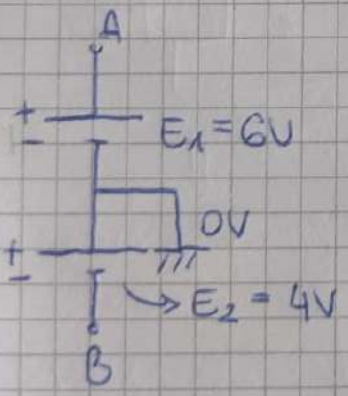
simbolo  0V (zero volt) oppure  0V

DATI GLI SCHEMI ELETTRICI DETERMINARE LE TENSIONI $V_A$, $V_B$ RIFERITE ALLA TERRA




$V_A = E_1 - E_2 = 2V$

$V_B = -3V$




$V_A = 6V$

$V_B = -4V$

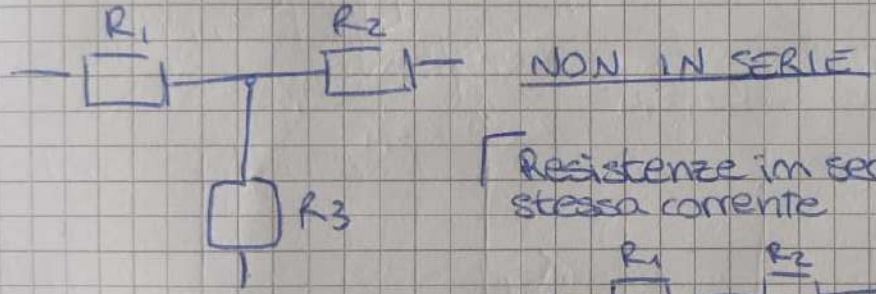
stessa

$\rightarrow E_2 = 4V$

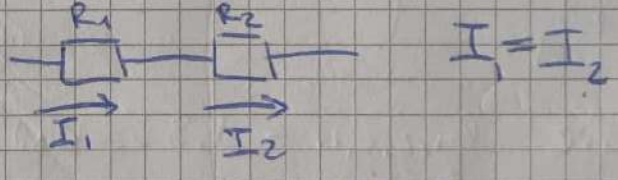
B

## RESISTENZE IN SERIE


Sono in serie quando hanno un solo morsetto in comune e a quel morsetto non sono collegate altre robe

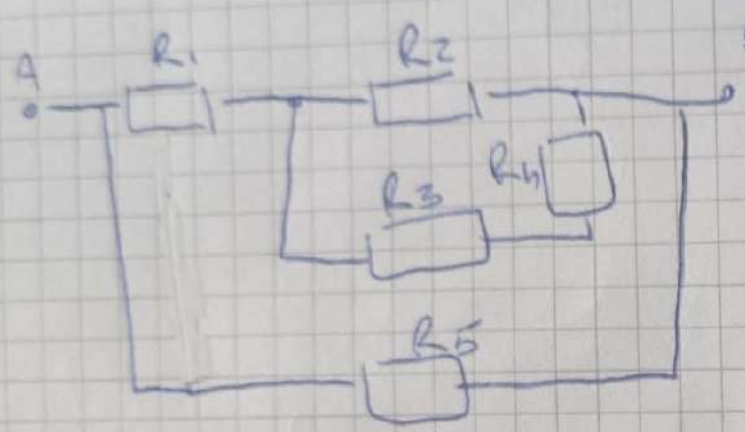



Resistenze in serie sono attraversate dalla stessa corrente




Le resistenze in serie si possono sommare ($R_{eq}$) e ottenere una resistenza equivalente.

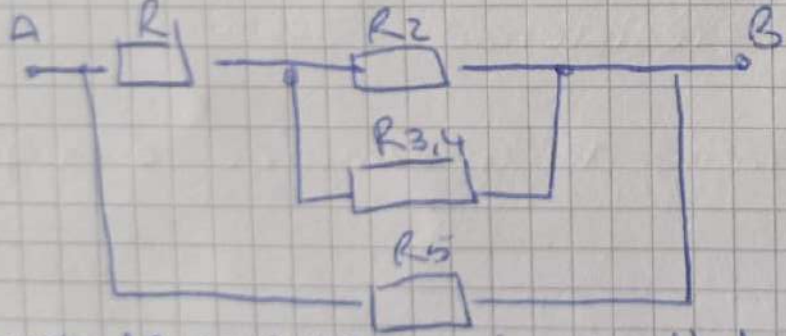
ESERCIZI




trovare la resistenza equivalente

$R_1 = 1k\Omega$ $R_2 = 2k\Omega$ $R_3 = 3k\Omega$ $R_4 = 600\Omega$

① trovare le resistenze in serie; R3 e R4 $R_{3,4} = 5k\Omega$




② trovare le resistenze in parallelo $R_{2,3,4} = \frac{R_2 \cdot R_{3,4}}{R_2 + R_{3,4}} = 0{,}833\,k\Omega \sim 833\Omega$

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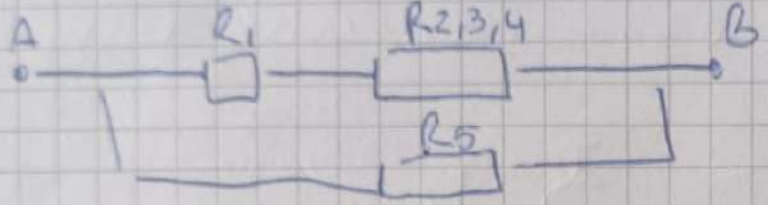
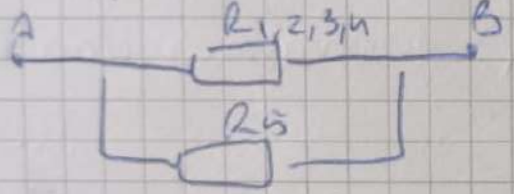
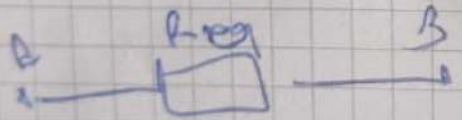
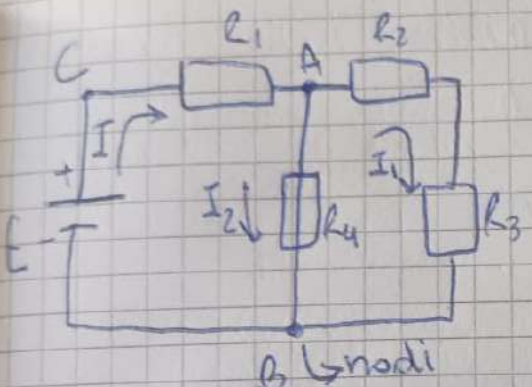



③ $R_1$ e $R_{2,3,4}$ in serie $R_{1,2,3,4} = 1{,}833\ k\Omega$




④ $R_{eq} = \frac{R_{1,2,3,4} \cdot R_5}{R_{1,2,3,4} + R_5} = 0{,}452\ k\Omega \sim 452\ \Omega$

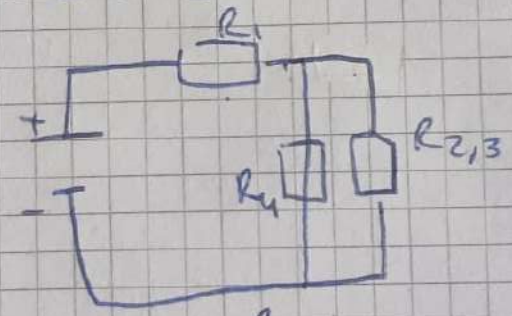



$E = 10V \quad R_1 = 10K\Omega \quad R_2 = 20K\Omega \quad R_3 = 15K\Omega$

$R_4 = 6K\Omega$

1) Calcolare la corrente erogata dal generatore con il metodo della resistenza equivalente tra C e B.



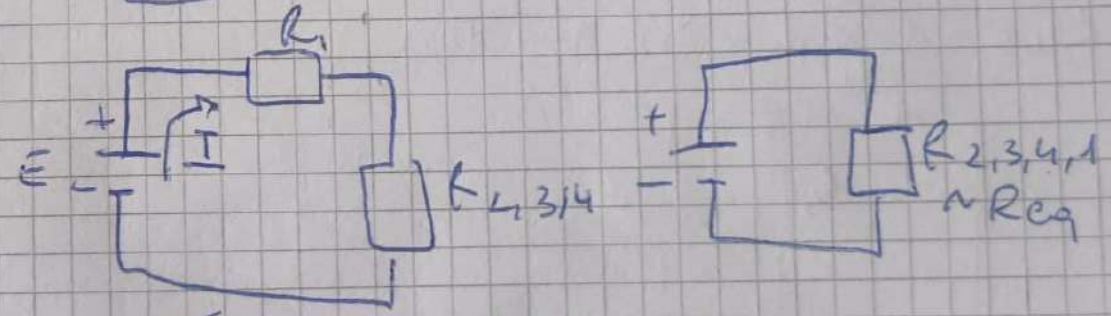

② $R_{2,3} = 35\ K\Omega$

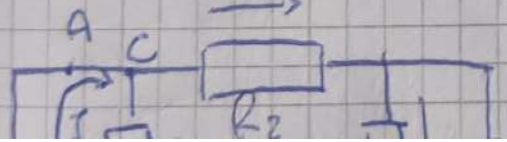
③ $R_{2,3,4} = 22,75K\Omega$

④ $R_{2,3,4,1} = 32,75K\Omega$

$\sim R_{eq}$

⑤ $I = \frac{E}{R_{eq}} = 0,305mA$



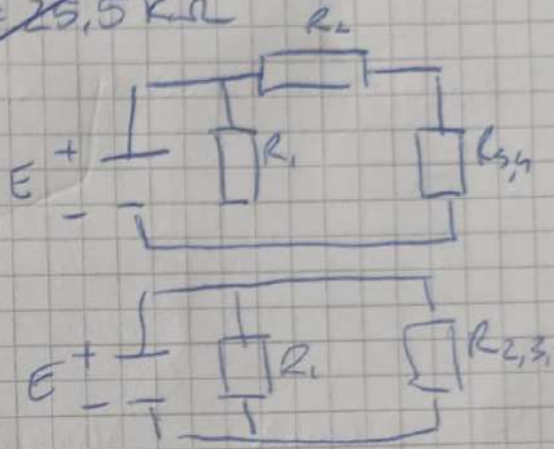




$I_4 \quad R_{1,3} = \frac{10 \cdot 15}{} = \frac{150}{} = 6K\Omega$

B

$R_{eq} = R_{1,3,4,2} = 5,5 + 20 = 25,5\ K\Omega$

$I = \frac{E}{R_{eq}} = 0,392\ mA$




$R_{3,4} = \frac{15 \cdot 65}{15+65} = 12,2\ K\Omega$

$\Omega \sim 833\ \Omega$

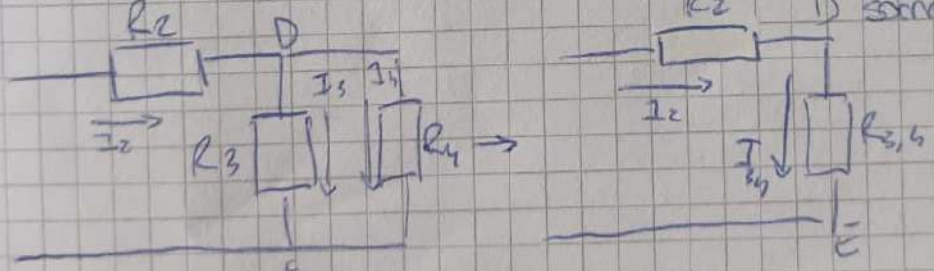
$R_{2,3,4} = 12,9 + 20 = 32,2\ K\Omega$

$R_{eq} = \frac{32,2 \cdot 10}{32,2+10} = 7,63\ K\Omega$

$I = \frac{10V}{7,63k\Omega} = 1,31\ mA$

$I_1 = \frac{E}{R_1} = \frac{10V}{10K\Omega} = 1mA$

$I_2 = I - I_1$ → principio delle correnti somma correnti entranti = somma correnti uscenti

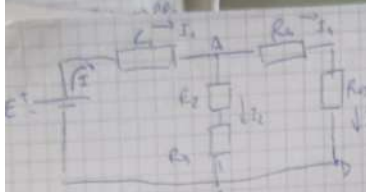



$V_{DE} = R_{3,4} \cdot I_2 = 3,78\ V$

$I_3 = \frac{V_{DE}}{R_3} = 0,252\ mA$

$I_4 = \frac{V_{DE}}{R_4} = 0,0582\ mA$

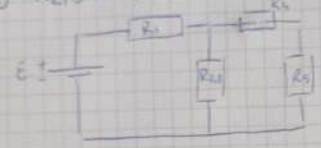
$I_4 = I_2 - I_3$



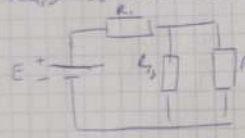
$R_1 = 2K\Omega$ $R_{46} = 10K\Omega$
$R_2 = 4K\Omega$ $R_5 = 5K\Omega$
$R_3 = 6K\Omega$ $E = 20V$

indicare le correnti in modo che siano positive

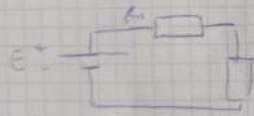
① $R_{2,3} = 4K\Omega + 6K\Omega = 10K\Omega$



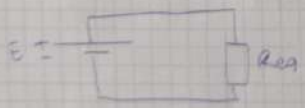
② $R_{4,5} = 10K\Omega + 5K\Omega = 15K\Omega$



③ $R_{2,3,4,5} = \frac{10K\Omega \cdot 15K\Omega}{10K\Omega + 15K\Omega} = 6K\Omega$

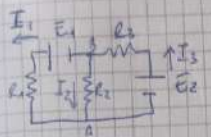


④ $R_{2,3,4,5,1} = 6K\Omega + 2K\Omega = 8K\Omega$

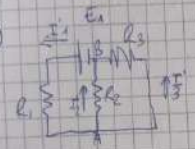


$I = \frac{E}{R_{eq}} = 2,5mA$ $V_{AB} = R_{2,3,4,5} \cdot I = 15V$ $I_2 = \frac{V_{AB}}{R_{2,3}} = 1,5mA$

$I_4 = I - I_2 = 1mA$




$E_1 = 10V$
$E_2 = 15V$
$R_1 = 100\Omega \quad R_2 = 400\Omega \quad R_3 = 600\Omega$

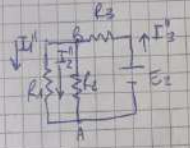
① 


$R_{2,3} = \frac{R_2 \cdot R_3}{R_2 + R_3} = 240\Omega$

$I_1' = \frac{E_1}{R_1} = 100mA$

$V_{AB} = R_{2,3} \cdot I_1' = 24V$

$I_2' = \frac{V_{AB}}{R_2} = 60mA$

② 


$R_{1,2} = \frac{R_1 \cdot R_2}{R_1 + R_2} = 80\Omega$

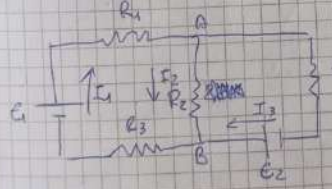
$I_3'' = \frac{E_2}{R_3} = 25mA$

$V_{AB} = R_{1,2} \cdot I_3'' = 2V$

$I_2'' = \frac{V_{AB}}{R_2} = 5mA$

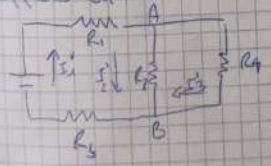
③ $I_2 = I_2' + I_2'' = 65mA$

esercizio in classe




$E_1 = 14V \quad E_2 = 16V$
$R_1 = 1K \quad R_2 = 2,5K \quad R_3 = 1,5K \quad R_4 = 1,2K$
trovare $I_1$ e $I_2$ con la sovrapposizione degli effetti

effetto $E_1$




$R_{eq} = R_1 + \frac{R_2 + R_4}{R_2 + R_4} + R_3 = 2,5K$

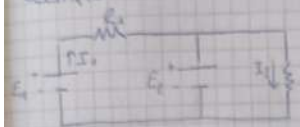
$I_1' = \frac{E_1}{R_{eq}} =$

$I_2' = \frac{V_{AB}}{R_2} =$

$V_{AB} = I_1' \cdot R_{24} =$

## PRINCIPIO DI SOVRAPPOSIZIONE DEGLI EFFETTI

esempio

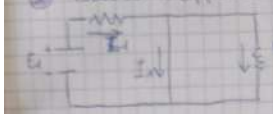


$E_1 = 12V \quad E_2 = 5V$

$R_1 = 200\Omega \quad R_2 = 500\Omega$

Calcolare la corrente $R_1$ con la sovrapposizione degli effetti

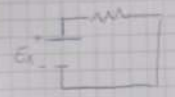
① valuto effetto del generatore $E_1$ ($E_2$ cortocircuitato)



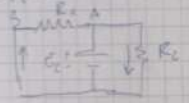
$I'_1$: corrente dovuta al solo generatore $E_1$

$I'_2 = I_1$ $R_2$ e $E_2$ è come se non ci fosse

$I'_1 = \frac{E_1}{R_1} = 0,06A = 60mA$



② effetto di $E_2$ ($E_1$ cortocircuitato)

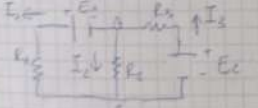


$I''_1 = \frac{V_{AB}}{R_1} = -25mA \quad V_{AB} = 5V$ (del generatore)

③ calcolo della somma degli effetti

$I_1 = I'_1 + I'_2 = 25mA$

ES PER CASA

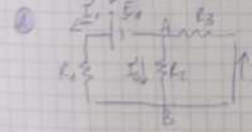


$E_1 = 10V \quad E_2 = 15V \quad R_1 = 100\Omega \quad R_2 = 400\Omega \quad R_3 = 600\Omega$

Verso della corrente uscente dal polo positivo

Trovare $I_2$ con sovrapposizione degli effetti

①

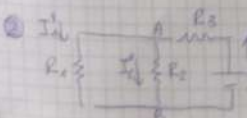


$R_{2,3} = \frac{R_2 R_3}{R_2 + R_3} = 240\Omega \quad R_{eq} = R_1 + R_{2,3} = 340\Omega$

$I'_1 = \frac{E_1}{R_{eq}} = 29,4mA \quad V_{AB} = R_{2,3} \cdot I'_1 = 7,06V$

$I'_2 = \frac{V_{AB}}{R_2} = 17,7mA$

②



$R_{1,2} = \frac{R_1 R_2}{R_1 + R_2} = 80\Omega \quad R_{eq} = R_{1,2} + R_3 = 680\Omega$

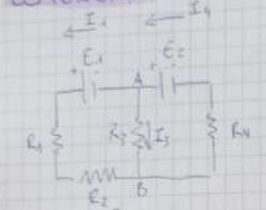
$I''_3 = \frac{E_2}{R_{eq}} = 27,1mA \quad V_{AB} = R_{1,2} \cdot I''_3 = 1,77V$

$I'_2 = \frac{V_{AB}}{R_2} = -4,43mA$

tavi LSI
memorie
microprocessori/
microcontrollori

⑤ $I_2 = I_2' + I_2'' = 13,3 mA$

ES PER CASA




$E_1 = 10V \quad E_2 = 14V$

$R_1 = 2K\Omega \quad R_3 = 5K\Omega \quad R_2 = 3K\Omega \quad R_4 = 1,5K\Omega$

$I_2 = ? \quad I_3 = ?$

① $R_{eq} = R_1 + R_2 + R_{3,4} = 5,15K\Omega$

$I_1' = \frac{E_1}{R_{eq}} = 1,63mA \qquad I_3' = \frac{V_{AB}}{R_3} = -374\mu A$

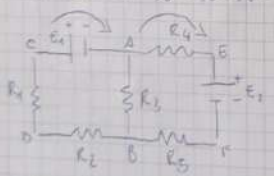
$V_{AB} = I_1' \cdot R_{3,4} = 1,87V \qquad I_2' = I_1' - I_3' = 2,00mA$

② $R_{eq} = \frac{(R_1+R_2)\cdot R_3}{R_1+R_2+R_3} + R_4 = 4K\Omega$

$I_2'' = \frac{E_2}{R_{eq}} = 5,5mA \qquad V_{AB} = I_2'' \cdot R_{1,2,3} = 8,75V$

$I_3'' = \frac{V_{AB}}{R_3} = 1,75mA$

③ $I_3 = I_3' + I_3'' = 1,38mA \qquad I_2 = I_2' + I_2'' = 5,5mA$




nodi: A, B

rami: 3

maglie: DCABD; BAEFB; DCEFD

Principio correnti si applica ai nodi

nodo A: $I_2 = I_1 + I_3$ (entrante / uscente)

nodo B: $I_1 + I_3 = I_2$ (entrante / uscente)

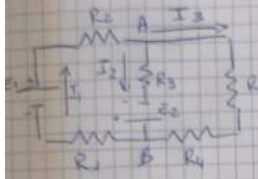
Principio tensione si applica alle maglie

maglia sx: $V_{R1} - E_1 - V_{R3} + V_{R2}$ maglia dx: $V_{R3} + V_{R4} - E_2 + V_{R2}$

maglia esterna: $V_{R1} - E_1 + V_{R4} - E_2 + V_{R3} + V_{R2}$

I1 = I2 - I3
V1R1 + V2R2 + V3R3 = 0
Si usa così nel momento in cui I1, I2, I3
(ti manca tutto)

RECUPERO TEORIA




DATI:

$E_1 = 10\,V \quad E_2 = 6\,V$

$R_1 = 200\,\Omega \quad R_2 = 100\,\Omega$

$R_3 = 300\,\Omega \quad R_4 = 250\,\Omega$

$R_5 = 450\,\Omega$

CONSEGNE:

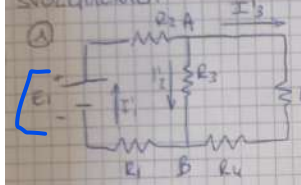
1) Trovare $I_1, I_2, I_3$

2) principio corrente nodo A

3) principio tensione maglia esterna

↓ Kirchhoff

SVOLGIMENTO:




$R_{4,5} = R_4 + R_5 = 250 + 450 = 700\,\Omega$

$R_{4,5,3} = \frac{R_{4,5} \cdot R_3}{R_{4,5} + R_3} = \frac{700 \cdot 300}{1000} = 210\,\Omega$

$R_{eq} = R_{4,5,3} + R_1 + R_2 = 210 + 200 + 100 = 510\,\Omega$

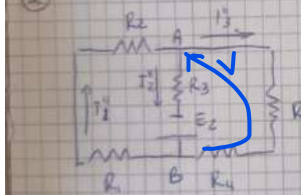
$I'_1 = \frac{E_1}{R_{eq}} = \frac{10}{510} = 19{,}6\,mA$

$E_1 \approx V_1$

$V_{AB} = I'_1 \cdot R_{3,4,5} = 4{,}12\,V$

$I'_2 = \frac{V_{AB}}{R_3} = 13{,}7\,mA$

$I'_3 = I'_1 - I'_2 = 19{,}6\,mA - 13{,}7\,mA = 5{,}87\,mA$




$R_{4,5} = R_4 + R_5 = 250 + 450 = 700\,\Omega$

$R_{1,2} = R_1 + R_2 = 200 + 100 = 300\,\Omega$

$R_{eq} = \frac{R_{4,5} \cdot R_{1,2}}{R_{4,5} + R_{1,2}} + R_3 = \frac{700 \cdot 300}{1000} + 300 = 510\,\Omega$

$I''_2 = \frac{E_2}{R_{eq}} = \frac{6}{510} = 11{,}8\,mA$

$V_{AB} = I''_2 \cdot R_{1,2,4,5} = 11{,}8 \cdot 210 = 2{,}48\,V$

$I''_1 = \frac{V_{AB}}{R_{1,2}} = \frac{2{,}48}{300} = 8{,}26\,mA$

$I''_3 = I''_1 - I''_2 = 8{,}26 - 11{,}8 = -3{,}53\,mA$

③

$I_1 = I'_1 + I''_1 = 19{,}6 + 8{,}26 = 27{,}9\,mA$

$I_2 = I'_2 + I''_2 = 13{,}7 + 11{,}8 = 25{,}5\,mA$

$I_3 = I'_3 + I''_3 = 5{,}87 - 3{,}53 = 2{,}34\,mA$

2) $I_1 = I_2 + I_3 = 25{,}5 + 2{,}34 = 27{,}8\,mA$ verificato (sì)

3)