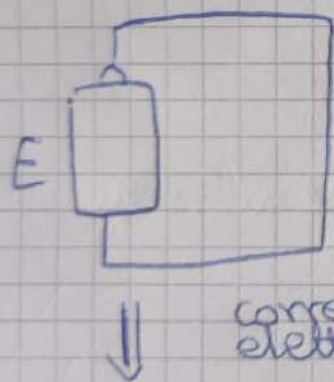
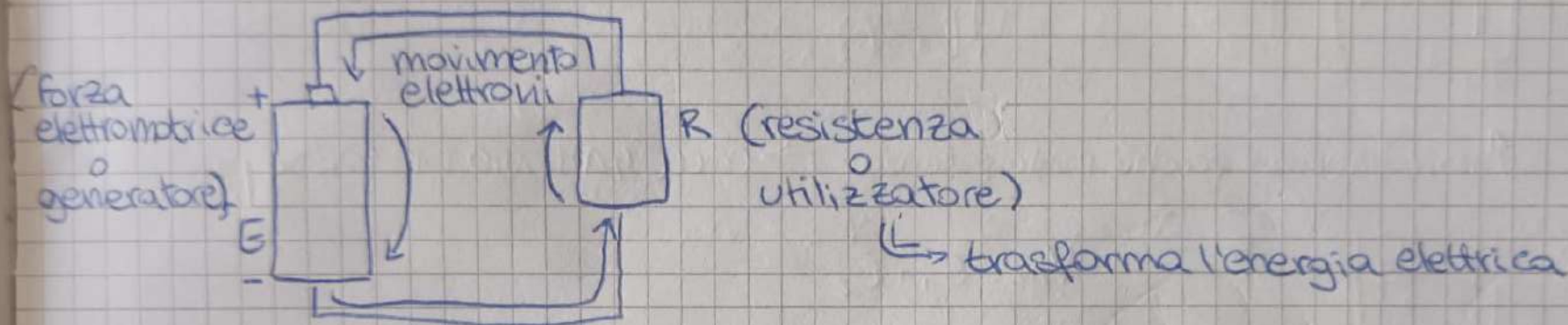


CIRCUITO ELETTRICO ELEMENTARE

62

1/2K



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

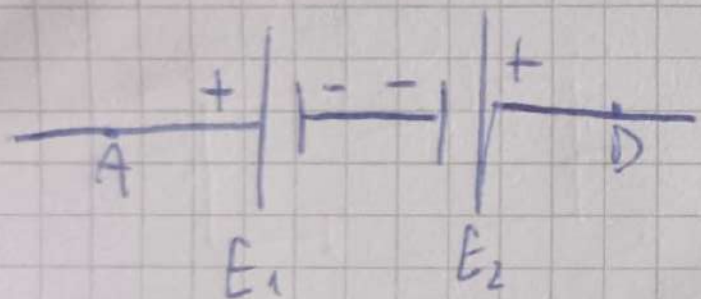
$$I = \frac{E}{R}$$

corto circuito \rightarrow 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

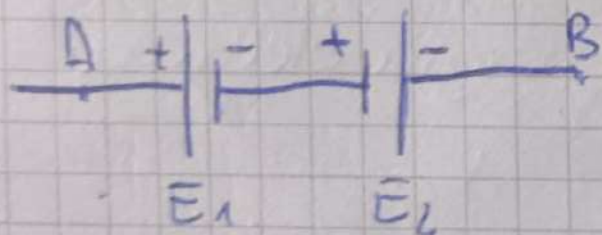
ntrolls mi

CIRCUITI IN PARALLELO



$$V_{AD} = V_{AB} + V_{CD} = E_1 - E_2$$

↑ non ha senso perché perdo potenza → COLLEGAMENTO DISCORDE

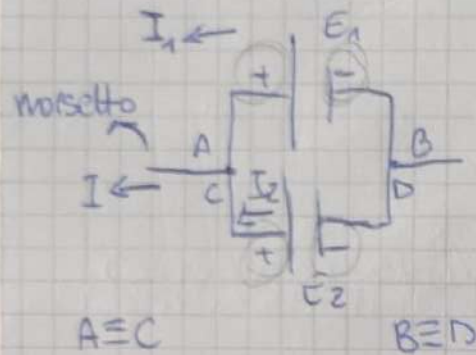


$$V_{AB} = E_1 + E_2$$

↑ COLLEGAMENTO CONCORDE

COLLEGAMENTO DISCORDE

COLLEGAMENTO IN PARALLELO

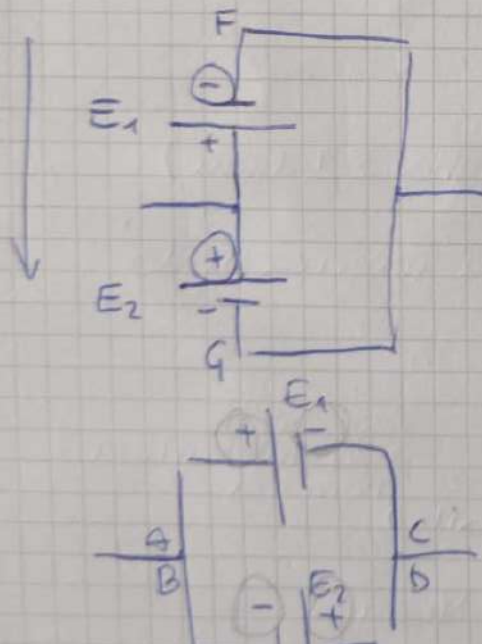


sono in parallelo se hanno i 2 morsetti in comune

$$I = I_1 + I_2$$

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



$$V_{FG} = -E_1 + E_2$$

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

NO! CORTOCIRCUITO.

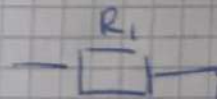
$$V_{AB} \neq V_{CD}$$

$$E_1 \neq E_2$$

RESISTENZE IN





Sono in serie morsetto non



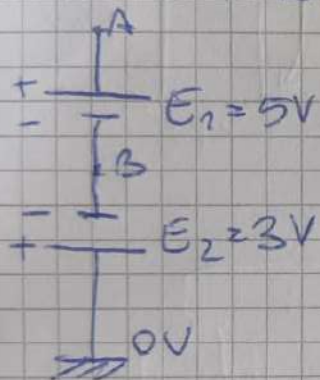
Le resistenze in equivalente.

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)

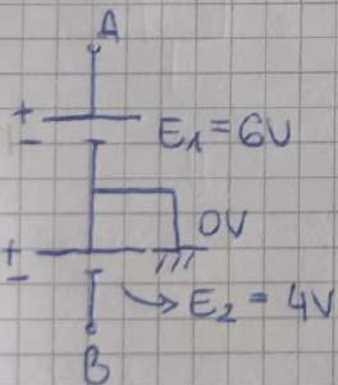
simbolo  0V (zero volt) oppure  0V

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



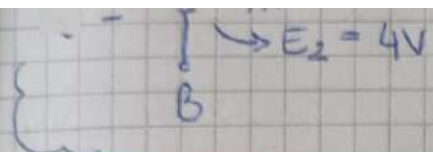
$$V_A = E_1 - E_2 = 2V$$

$$V_B = -3V$$

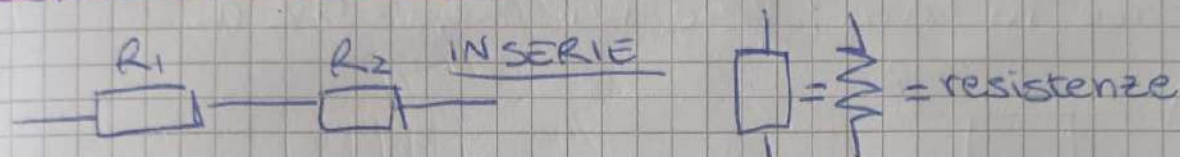


$$V_A = 6V$$

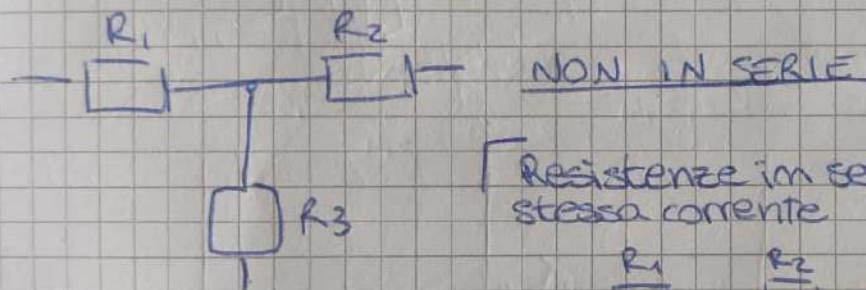
$$V_B = -4V$$



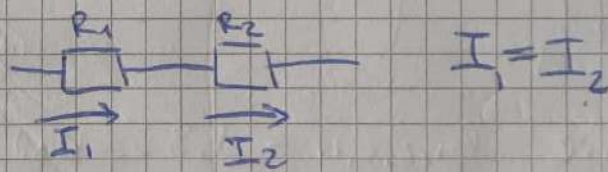
RESISTENZE IN SERIE



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

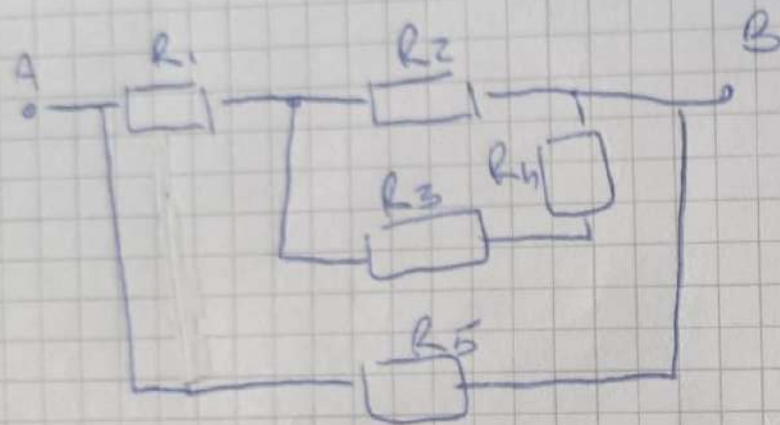


Resistenze in serie sono attraversate dalla stessa corrente



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

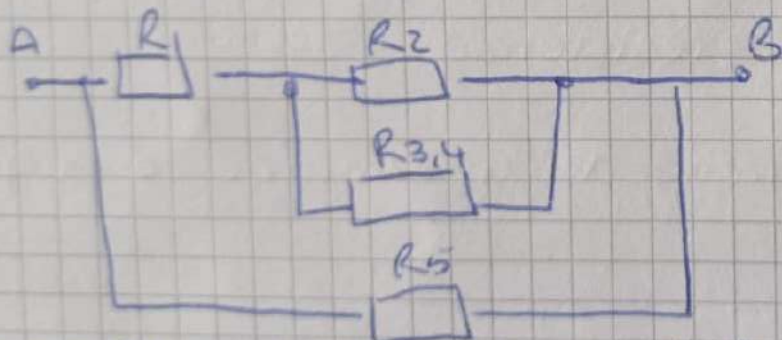
ESERCIZIO



trovare la resistenza equivalente

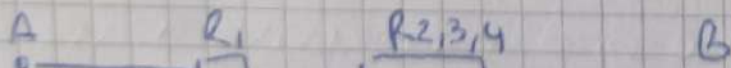
$$R_1 = 1\text{ k}\Omega \quad R_3 = 2\text{ k}\Omega \quad R_4 = 3\text{ k}\Omega \quad R_5 = 600\Omega$$

① trovare le resistenze in serie; R_3 e R_4 $R_{3,4} = 5\text{ k}\Omega$



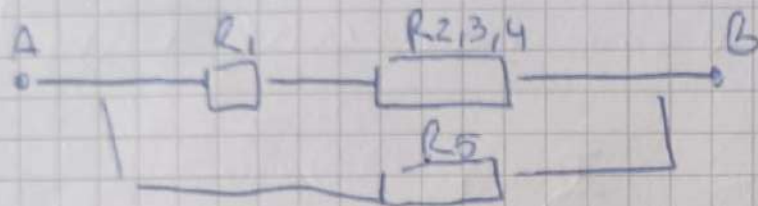
② trovare le resistenze in parallelo

$$R_{2,3,4} = \frac{R_2 \cdot R_{3,4}}{R_2 + R_{3,4}} = \frac{3\text{ k}\Omega \cdot 5\text{ k}\Omega}{3\text{ k}\Omega + 5\text{ k}\Omega} = 0,833\text{ k}\Omega \approx 833\Omega$$

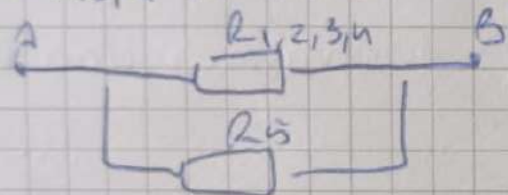


① trovare le resistenze in parallelo

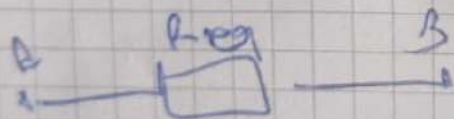
$$R_{2,3,4} = \frac{R_2 \cdot R_{3,4}}{R_2 + R_{3,4}} \approx 0,833 \text{ k}\Omega \sim 833 \Omega$$



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

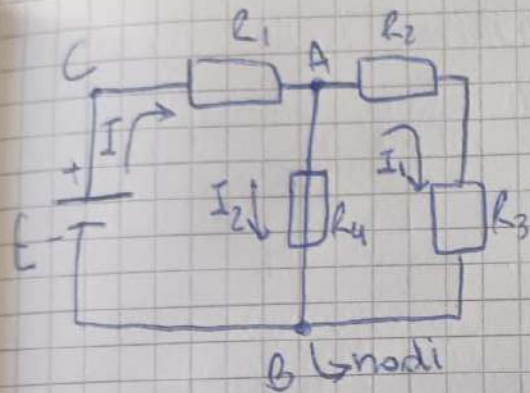


④ $R_{eq} = \frac{R_{1,2,3,4} \cdot R_5}{R_{1,2,3,4} + R_5} \approx 0,452 \text{ k}\Omega \sim 452 \Omega$



BB
BB

BB

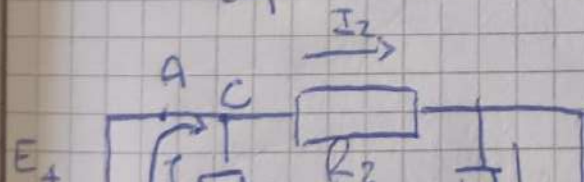
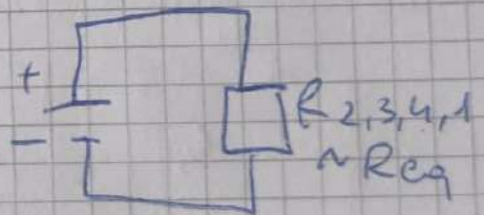
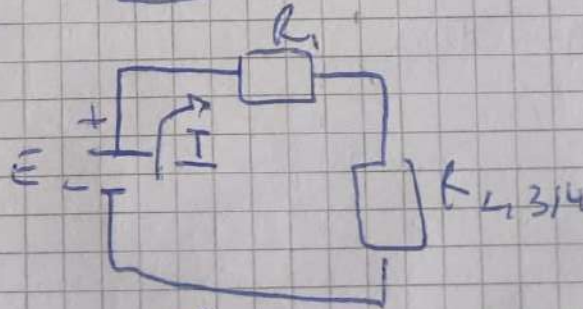
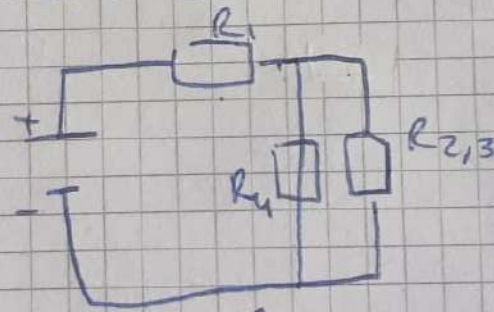


$E = 10V$ $R_1 = 10K\Omega$ $R_2 = 20K\Omega$ $R_3 = 15K\Omega$
 $R_4 = 65K\Omega$

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

- ① $R_{2,3} = 35 K\Omega$
- ② $R_{2,3,4} = 22,75 K\Omega$
- ③ $R_{2,3,4,1} = 32,75 K\Omega$
 $\sim R_{eq}$

④ $I = \frac{E}{R_{eq}} = 0,305 mA$



$R_{2,3} = \frac{10 \cdot 15}{10 + 15} = \frac{150}{25} = 6 K\Omega$

3

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

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

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

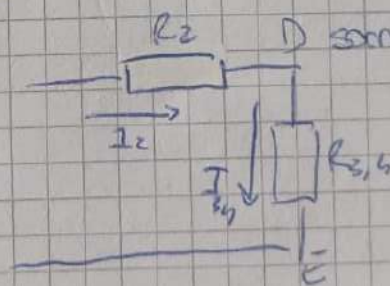
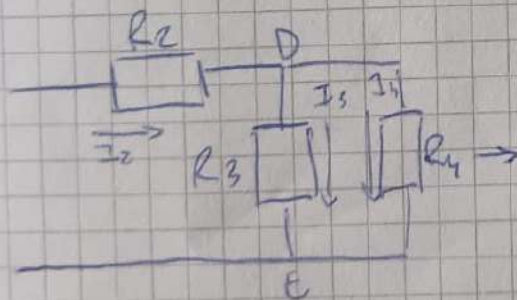
$$R_{2,3,4} = 12,9 + 20 = 32,2 \text{ k}\Omega$$

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

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

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

$$I_2 = I - I_1 \rightarrow \text{principio delle correnti} \quad \text{somma correnti entranti} = \text{somma correnti uscenti}$$

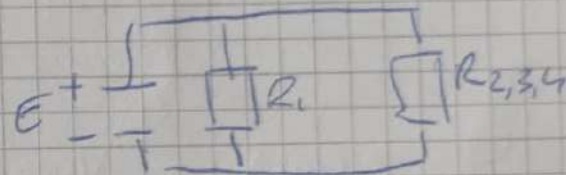
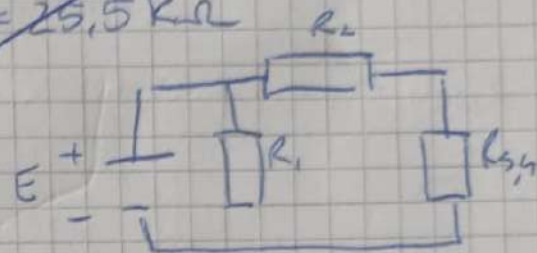


$$V_{DE} = R_{3,4} \cdot I_2 = 3,78 \text{ V}$$

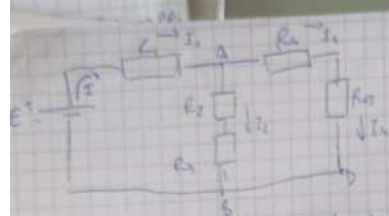
$$I_4 = \frac{V_{DE}}{R_4} = 0,0582 \text{ mA}$$

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

$$I_4 = I_2 - I_3$$



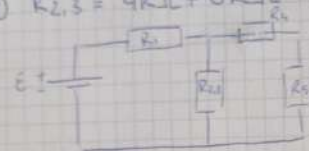
opracování/
kontrola



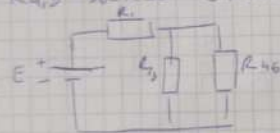
$$\begin{aligned} R_1 &= 2\text{k}\Omega & R_{45} &= 10\text{k}\Omega \\ R_2 &= 4\text{k}\Omega & R_5 &= 5\text{k}\Omega \\ R_3 &= 6\text{k}\Omega & E &= 20\text{V} \end{aligned}$$

indicare le correnti in modo che siano positive

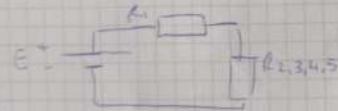
$$① R_{2,3} = 4\text{k}\Omega + 6\text{k}\Omega = 10\text{k}\Omega$$



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



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

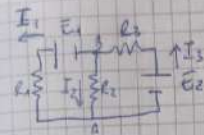


$$④ R_{2,3,4,5,1} = 6\text{k}\Omega + 2\text{k}\Omega = 8\text{k}\Omega$$



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

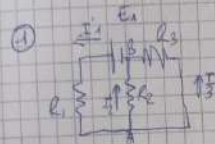
$$I_4 = I - I_2 = 1\text{mA}$$



$$E_1 = 10V$$

$$E_2 = 15V$$

$$R_1 = 100\Omega \quad R_2 = 400\Omega \quad R_3 = 600\Omega$$

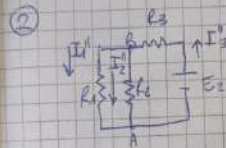


$$R_{2,3} = \frac{R_2 \cdot R_3}{R_2 + R_3} = 240\Omega$$

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

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

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



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

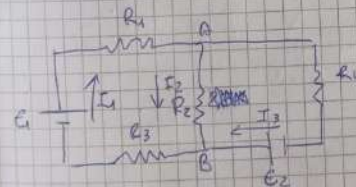
$$I_3 = \frac{E_2}{R_3} = 25mA$$

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

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

$$I_2 = I_2' + I_2'' = 65mA$$

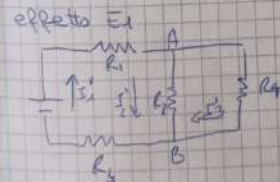
esercizio in classe



$$E_1 = 14V \quad E_2 = 16V$$

$$R_1 = 1K \quad R_2 = 2.5K \quad R_3 = 1.5K \quad R_4 = 1.2K$$

trovare I_1 e I_2 con la sovrapposizione degli effetti



$$R_{eq} = R_1 + \frac{R_2 \cdot R_4}{R_2 + R_4} + R_3 = 9.5K$$

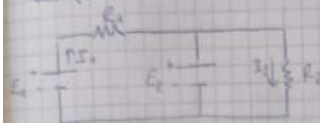
$$I_1 = \frac{E_1}{R_{eq}} =$$

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

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

PRINCIPIO DI SOVRAPPOSIZIONE DEGLI EFFETTI

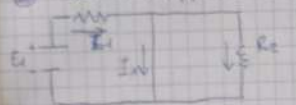
esempio



$$E_1 = 12V \quad E_2 = 5V \\ R_1 = 200\Omega \quad R_2 = 500\Omega$$

Calcolo della corrente I_2 con la sovrapposizione degli effetti

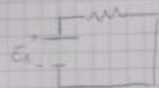
1) valore effetto del generatore E_1 (E_2 cortocircuitato)



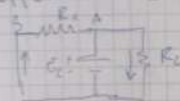
I_1 : corrente dovuta al solo generatore E_1

$I_2 = I_1$ R_2 è in serie non ci fosse

$$I_1 = \frac{E_1}{R_1} = 0,055A = 55mA$$



2) effetto di E_2 (E_1 cortocitato)

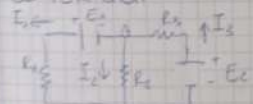


$$I_2' = \frac{V_{AB}}{R_2} = 25mA \quad V_{AB} = 5V \text{ (del generatore)}$$

3) calcolo della somma degli effetti

$$I_2 = I_1 + I_2' = 25mA$$

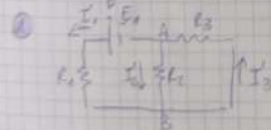
ES PER CASA



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

Verbo della corrente uscente dal polo positivo

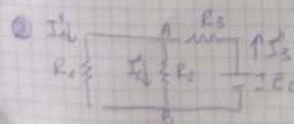
Trovare I_2 con sovrapposizione degli effetti



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

$$I_1 = \frac{E_1}{R_{eq}} = 29,4mA \quad V_{AB} = R_{2,3} \cdot I_1 = 7,06V$$

$$I_2' = \frac{V_{AB}}{R_2} = 17,7mA$$



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

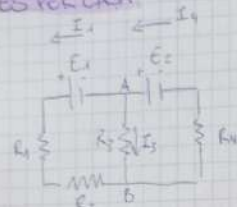
$$I_2'' = \frac{E_2}{R_{eq}} = 27,1mA \quad V_{AB} = R_{1,2} \cdot I_2'' = 1,77V$$

$$I_2 = \frac{V_{AB}}{R_2} = -4,43mA$$

tivi LSI
 e memoria
 microprocessori/
 microcontrollori

⑤ $I_2 = I_2' + I_2'' = 13,3 \text{ mA}$

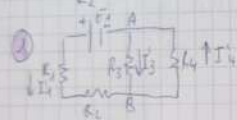
ES PER CASA



$E_1 = 10 \text{ V}$ $E_2 = 14 \text{ V}$

$R_1 = 2 \text{ k}\Omega$ $R_2 = 5 \text{ k}\Omega$ $R_3 = 3 \text{ k}\Omega$ $R_4 = 1,5 \text{ k}\Omega$

$I_2 = ?$ $I_3 = ?$



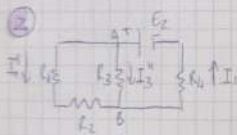
$R_{eq} = R_1 + R_2 + R_3 + R_4 = 5,15 \text{ k}\Omega$

$I_1 = \frac{E_1}{R_{eq}} = 1,63 \text{ mA}$

$I_3' = \frac{V_{AB}}{R_3} = -374 \mu\text{A}$

$V_{AB} = I_1 \cdot R_2 = 1,87 \text{ V}$

$I_2' = I_1 - I_3' = 2,00 \text{ mA}$



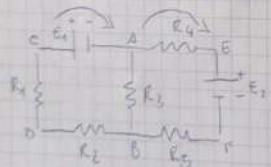
$R_{eq} = \frac{(R_1 + R_2) \cdot R_3}{R_1 + R_2 + R_3} + R_4 = 4 \text{ k}\Omega$

$I_2'' = \frac{E_2}{R_{eq}} = 5,5 \text{ mA}$

$V_{AB} = I_2'' \cdot R_{1,2,3} = 8,75 \text{ V}$

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

③ $I_3 = I_3' + I_3'' = 1,38 \text{ mA}$ $I_2 = I_2' + I_2'' = 5,5 \text{ mA}$



nod: A, B

rami: 3

maglie: DCABD, BAEFB, DCEFD

principio correnti si applica ai nodi

nod: A: $I_2 = I_1 + I_3$

emittente (I1) (I3) (I2)

nod: B: $I_4 + I_3 = I_2$

emittente (I4) (I3) (I2)

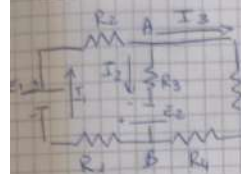
principio tensione si applica alle maglie

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

maglia di dx: $V_{R3} + V_{R1} - E_1 + V_{R4}$

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

RECUPERO TEORIA



DATI:

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

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

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

$$R_5 = 450\Omega$$

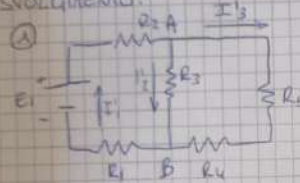
CONSEGNE:

1) trovare I_1, I_2, I_3

2) principio correnti nodo A

3) principio tensione maglia esterna

SVOLGIMENTO:



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

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

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

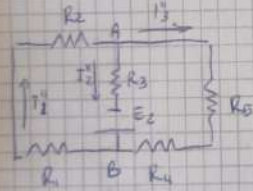
$$I_1 = \frac{E_1}{R_{eq}} = \frac{10}{510} = 19,6\text{ mA}$$

$$V_{AB} = I_1 \cdot R_{4,5,3} = 4,12\text{ V}$$

$$I_2 = \frac{V_{AB}}{R_3} = 13,7\text{ mA}$$

$$I_3 = I_1 - I_2 = 19,6\text{ mA} - 13,7\text{ mA} = 5,87\text{ mA}$$

(2)



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

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

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

$$I_2 = \frac{E_2}{R_{eq}} = \frac{6}{510} = 11,8\text{ mA}$$

$$V_{AB} = I_2 \cdot R_{1,2,4,5} = 11,8 \cdot 210 = 2,48\text{ V}$$

$$I_1 = \frac{V_{AB}}{R_{1,2}} = \frac{2,48}{300} = 8,26\text{ mA}$$

$$I_3 = I_1 - I_2 = 8,26 - 11,8 = -3,53\text{ mA}$$

(3) $I_1 = I_1' + I_1'' = 19,6 + 8,26 = 27,9\text{ mA}$

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

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

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

3)