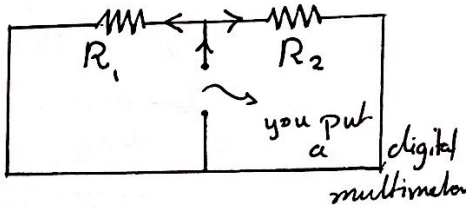
Expirement 4: Network Analysis II
The Thevenin and Norton Technique

1- **Thevenin**: "any network of resistors and supplies having two output terminals and supplies having two output terminals can be replaced by a series combinatio of $\mathcal{E}_{eq}$ & R_{eq} **By three steps:-** **Starting by R_3**

Step 1:- • you consider that- $\mathcal{E}_1$, $\mathcal{E}_2$ does not exist:-

• $R_{eq} = R_1 + R_2$

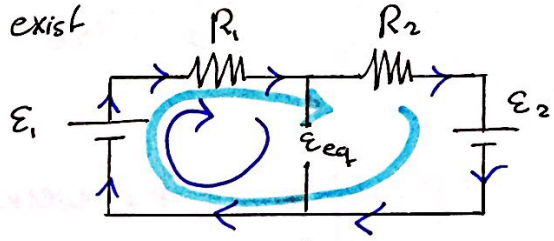
$$R_{eq_3} = \frac{R_1 R_2}{R_1 + R_2}$$



Step 2:- • you consider that $\mathcal{E}_1$, $\mathcal{E}_2$ exist

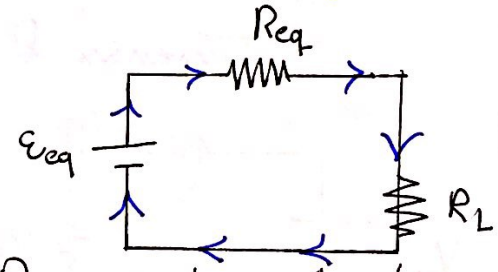
• $\mathcal{E}_{eq} = \mathcal{E}_1 - I R_1$ ---- ①

• you find I ---- ②



Step 3: • you find I_{eq_3}

$$I_{eq_3} = \frac{\mathcal{E}_{eq}}{R_{eq} + R_L}$$



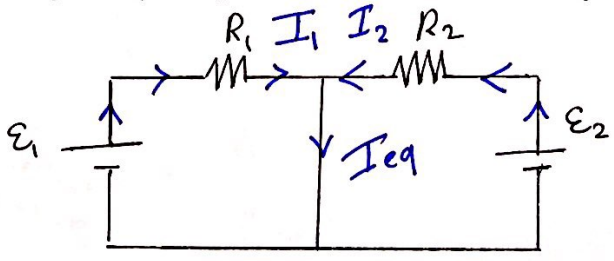
• You do the same for R_1 and R_2 and you find I_{eq_1} and I_{eq_2}

2- **Norton's** **for R_3**

Step 1: - The same

Step 2: $I_{eq_3} = I_1 + I_2$

$$= \frac{\mathcal{E}_1}{R_1} + \frac{\mathcal{E}_2}{R_2}$$

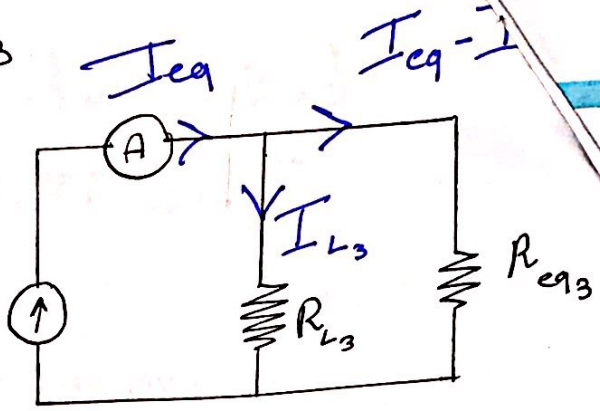


Step 3: get rid of $\mathcal{E}_1$, $\mathcal{E}_2$

Hiba Etaiwi

- you replace R_1, R_2 with Req_3
- $I_{L_3} R_3 = (I_{eq_3} - I_{L_3}) Req_3$

• على مبدأ تساوي الجهد عند التوصيل على التوازي



$$I_{L_3}(R_3) = I_{eq_3} Req_3 - I_{L_3} Req_3$$

$$I_{L_3}(R_3 + R_{eq_3}) = I_{eq_3} Req_3$$

(R_3 + R_{eq_3}: you have it — I_{eq_3}: you have it — Req_3: you have it)

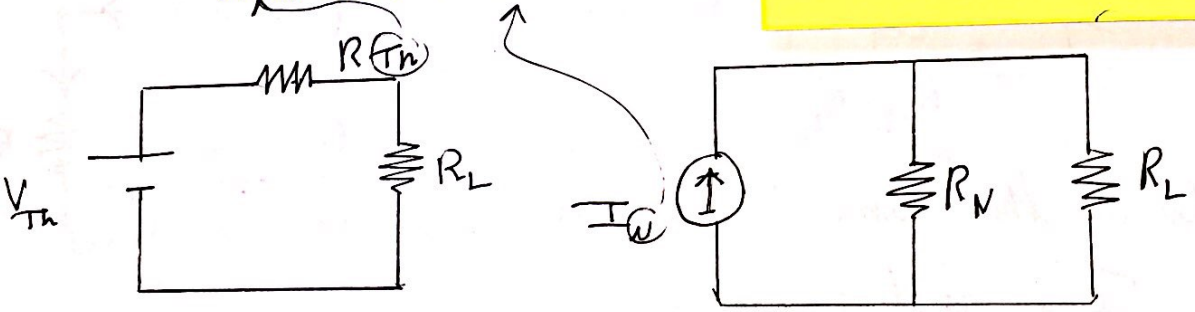
$$I_{L_3} = \frac{I_{eq_3} Req_3}{R_3 + Req_3}$$

- In Thevenin's

$$I_{L_3} = \frac{Eeq}{Req + R_L}$$

If you don't calculate Then I_{L_3}

Difference between Thevenin & Norton



$R_{Th} = R_L$

Alaa Khaiwi

- what we use
  - 2 voltage sources
  - 3 carbon Resistances
  - Circuit board
  - digital Multimeter

- DMM: digital Multimeter

- Procedure

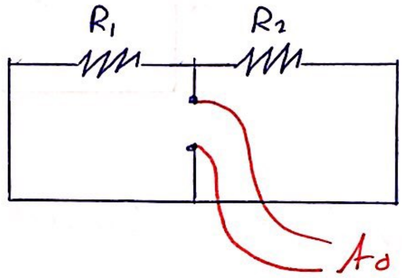
Thevenin :-

— There are 3 currents to measure each one we have 3 steps:- let's say we want to measure I_3

$I_L = I_3$
$R_L = R_3$

Step 1:- Calculate R_{eq}:-

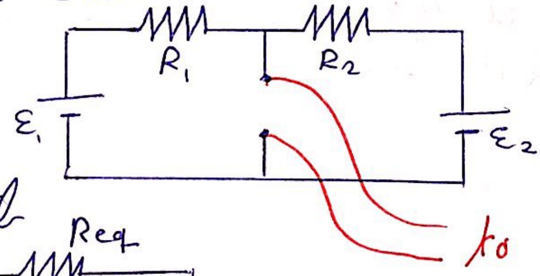
- first circuit :-
- Take ε_1 and ε_2 off.
- put a DMM in the place of R_3



to a DMM to measure R_{eq_3}

Step 2:- Calculate ε_{eq}:-

- second circuit :-
- Take R_3 off and put ε_1 and ε_2 back



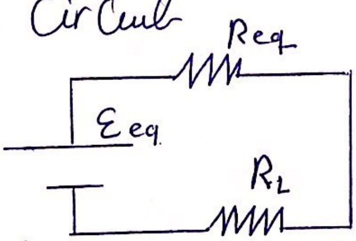
to a DMM to measure ε_{eq_3}

Step 3:-

- connect the Circuit

$R_L = R_3$

R_{eq} = you get it from the box



← to measure I_{eq_3}

- هناك ٣ تيارات، لقياس كل واحد نستعمل ٣ خطوات :-

١- الخطوة الأولى :- قم بإزالة $\varepsilon_1, \varepsilon_2$ وضع DMM مكان R_3 لقياس R_{eq_3}

٢- " الثانية :- " " R_3 وأرجع ε_1 و ε_2 لقياس ε_{eq_3}

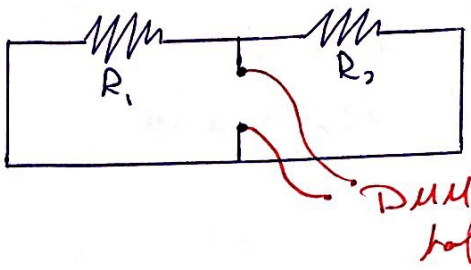
ε_{eq} = power supply

Alaa Ftaiwi

Norton :-

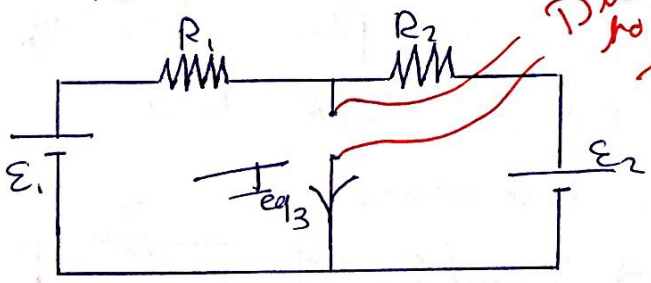
Step 1 :- The same as Thevenin's first step

نفس الخطوة الأولى في Thevenin.

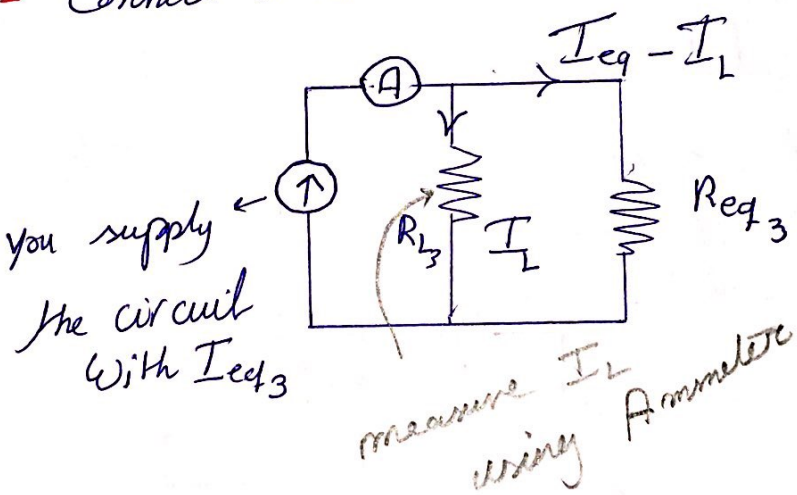


Step 2 :- measure I_{eq_3} :-

قيس I_{eq_3}.



Step 3 :- Connect this circuit



In Norton's

Req_1 = مجموع المقاومتين الأخريتين $R_2 + R_3$ مثلاً

R_1 = is the Thevenin Resistance

Alaa Etaiwi