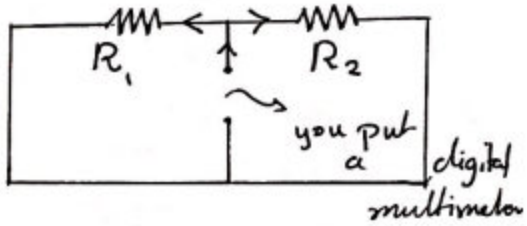
Expirement 4: Network Analysis II
The Thevenin and Norton Techniques

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:-

• $R_{eq} = R_1 + R_2$

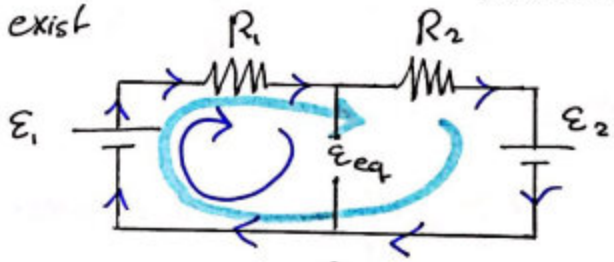
$$R_{eq_3} = \frac{R_1 R_2}{R_1 + R_2}$$



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

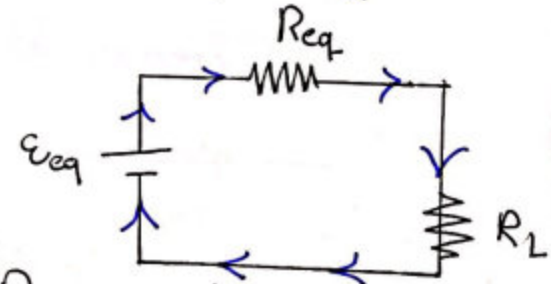
• $\mathcal{E}_{eq} = \mathcal{E}_1 - I R_1$ ---- ①

• 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}

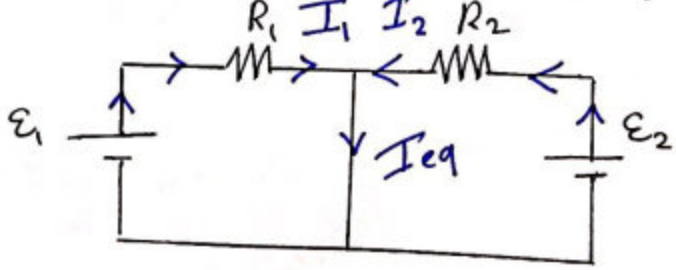
2- Norton's for R_3

Step 1:- The same

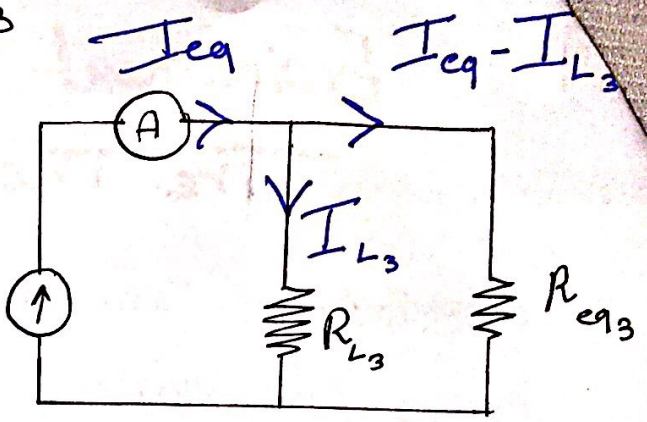
Step 2:- $I_{eq_3} = I_1 + I_2$

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

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



- 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

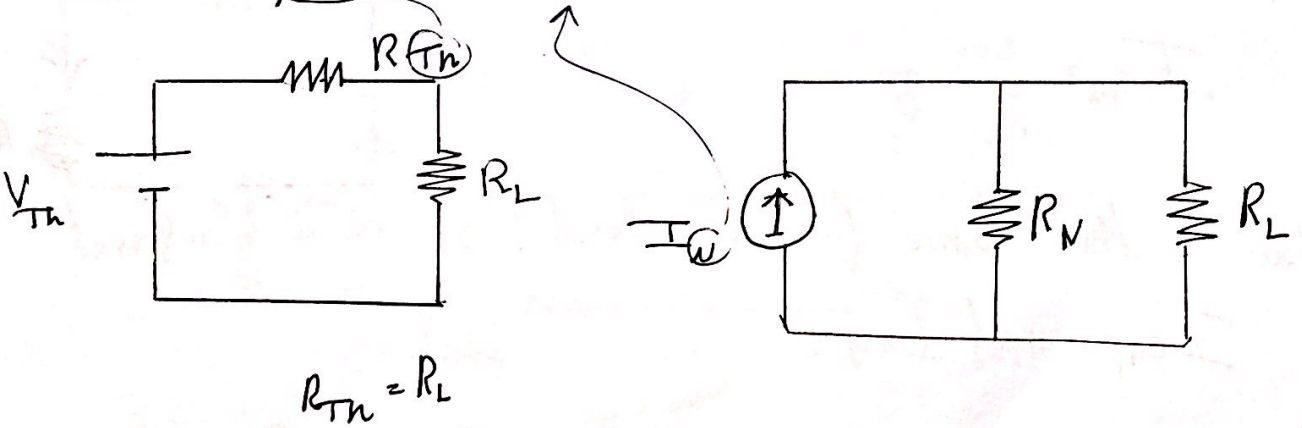
$$I_{L_3}(R_3) = I_{eq_3} Req_3 - I_{L_3} Req_3$$

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

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

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

Difference between Thevenin & Norton



$$R_{Th} = R_L$$

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

- DMM; digital Multimeter

- Procedure

Thevenin :-

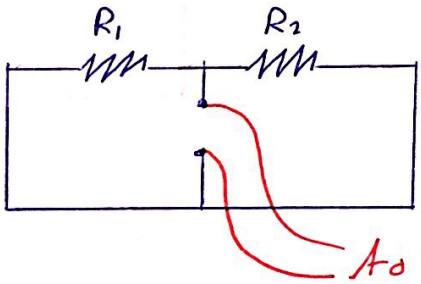
There are 3 currents to measure each one we have 3 steps:- let's say we want to measure I_3

$I_L = I_3$

$R_L = R_3$

Step 1:- Calculate R_{eq} :-

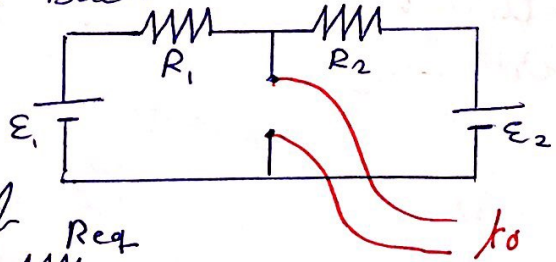
- first circuit :-
- Take $\mathcal{E}_1$ and $\mathcal{E}_2$ off
- Put a DMM in the place of R_3



to a DMM to measure R_{eq_3}

Step 2:- Calculate $\mathcal{E}_{eq}$:-

- second circuit :-
- Take R_3 off and put $\mathcal{E}_1$ and $\mathcal{E}_2$ back



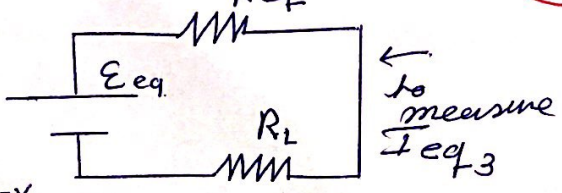
to a DMM to measure $\mathcal{E}_{eq_3}$

Step 3:-

- Connect the Circuit

$R_L = R_3$

R_{eq} = you get it from the box



← to measure I_{eq_3}

$\mathcal{E}_{eq}$ = Power Supply

- هناك ٢ تيارات ، لتيار كل واحد نستعمل ٢ خطوات :-

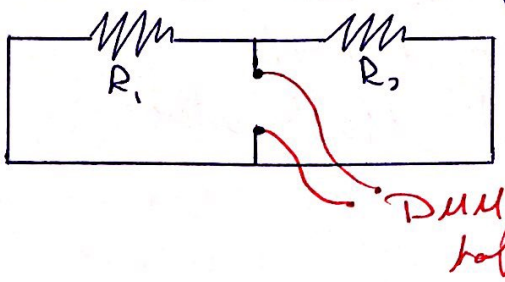
١- الخطوة الأولى :- قم بإزالة $\mathcal{E}_1, \mathcal{E}_2$ وضع DMM مكان R_3 لتيار R_{eq_3}

٢- " الثانية :- " R_3 وارجع $\mathcal{E}_1, \mathcal{E}_2$ لتيار $\mathcal{E}_{eq_3}$

Norton :-

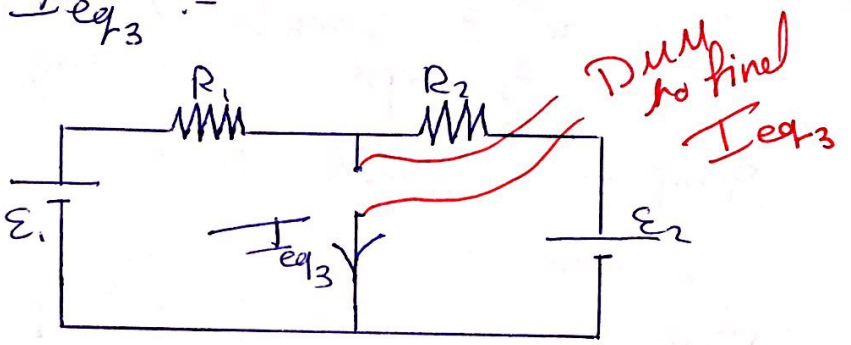
Step 1 :- The same as Thevenin's first step

نفس الخطوة الأولى في Thevinin.



Step 2 :- measure I_{eq_3} :-

I_{eq_3} نقيس.



Step 3 :- Connect this circuit