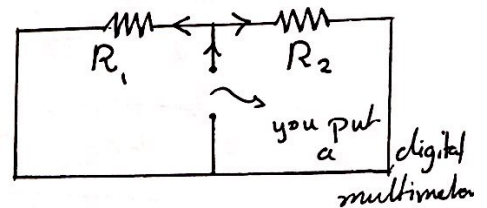# Expirement 4: Network Analysis II
The Thevenin and Norton Techniques

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

Step 1 :- • you consider that $\varepsilon_1, \varepsilon_2$ does not exist :-
- • $R_{eq} = R_1 + R_2$

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

R_1 R_2 you put a digital multimeter

Step 2 :- • you consider that $\varepsilon_1, \varepsilon_2$ exist
- • $\varepsilon_{eq} = \varepsilon_1 - IR_1$ ---- ①
- • you find I --- ②

ε_1 R_1 R_2 ε_2 ε_{eq}
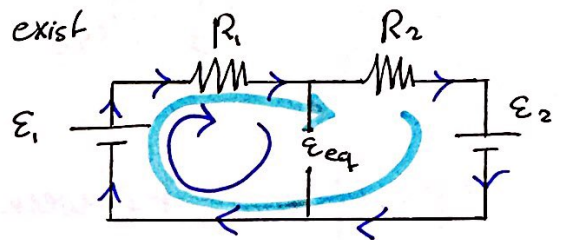
Step 3 :- • you find I_{eq_3}

$$I_{eq_3} = \frac{\varepsilon_{eq}}{R_{eq} + R_L}$$

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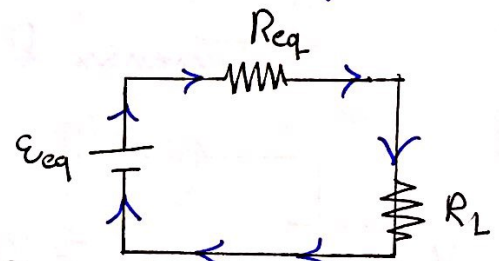
• You do the same for R_1 and R_2 and you find I_{eq_1} and I_{eq_2}

~·~·~·~·~·~·~·~·~·~·~·~

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

step 1 :- The same

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

$$= \frac{\varepsilon_1}{R_1} + \frac{\varepsilon_2}{R_2}$$

step 3 : getreedof $\varepsilon_1, \varepsilon_2$

ε_1 R_1 I_1 I_2 R_2 ε_2 I_{eq}

Alaa Etaiwi
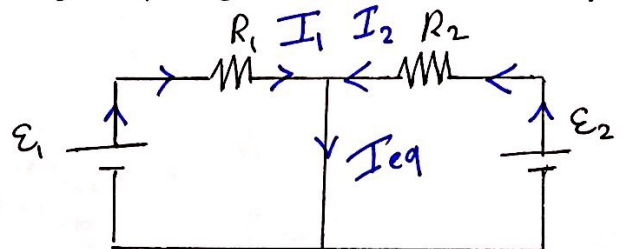
- you replace R_1, R_2 with Req_3
- $I_{L_3} R_3 = (Ieq_3 - I_{L_3}) Req_3$

على مبدأ تساوي الجهد عند التوصيل على التوازي
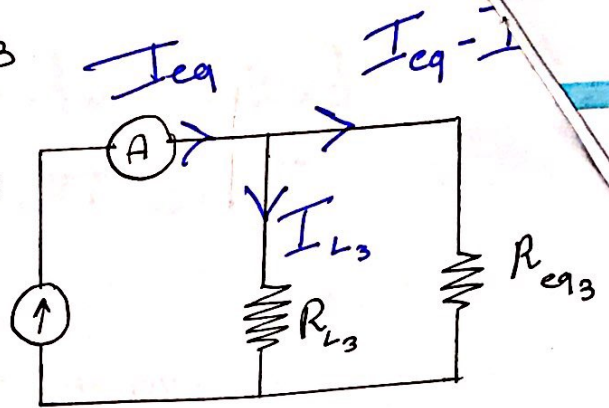
$$I_{L_3} (R_3) = Ieq_3 Req_3 - I_{L_3} Req_3$$

$$\underbrace{I_{L_3} (R_3 + Req_3)}_{\substack{\text{you have it}}} = \underbrace{Ieq_3}_{\substack{\text{you} \\ \text{have it}}} \underbrace{Req_3}_{\text{you have it}}$$

$$I_{L_3} = \frac{Ieq_3 \, Req_3}{R_3 + Req_3}$$

- 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 Htaiwi

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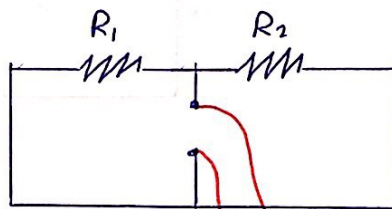 - digital Multimeter

- 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

R_1 R_2

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

R_1 R_2
$\mathcal{E}_1$ $\mathcal{E}_2$

to a DMM to measure $\mathcal{E}_{eq_3}$
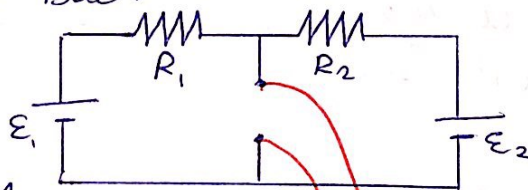
Step 3:-
- connect the Circuit
$R_L = R_3$

R_{eq}
$\mathcal{E}_{eq}$
R_L
to measure I_{eq_3}

R_{eq} = you get it from the box
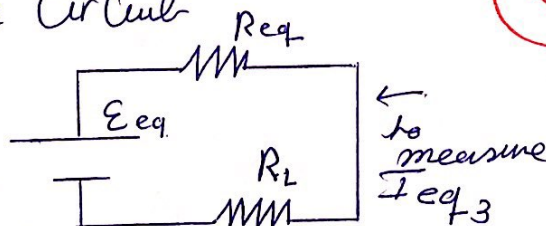
$\mathcal{E}_{eq}$ = Power Supply

Alaa Ftaiwi

R_{eq_3} نقيس DMM وضع $\mathcal{E}_2, \mathcal{E}_1$ نقوم بإزالة :- الخطوة الأولى -١
$\mathcal{E}_{eq_3}$ نقيس $\mathcal{E}_2, \mathcal{E}_1$ وإرجاع R_3 ~ ~ :- الثانية ~ -٢

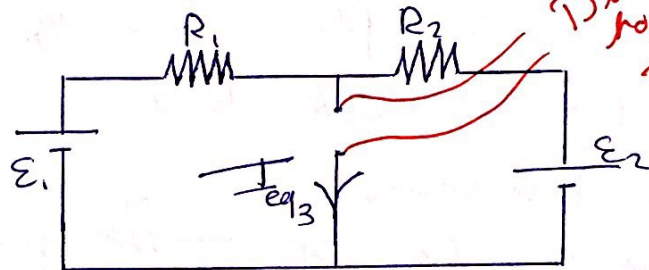• نقوم بـ ٢ بطارات، لقياس كل واحدة نحتاج ٤ خطوات :-

Norton :-

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

نفس خطوة أولى Therinn ن
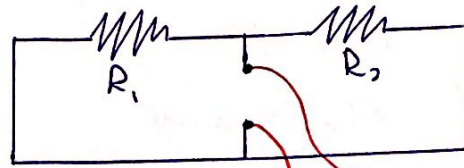
DMM
to find Req₃

Step 2 :- measure I_{eq_3} :-

I_{eq_3} نقيس.

DMM
to find
I_{eq_3}

Step 3 :- Connect this circuit

$I_{eq} - I_L$

you supply ←
the circuit
with I_{eq_3}

R_{L_3} I_L Req_3

measure I_L
using Ammeter

In Norton's
Req_1 = مجموع المقاومتين الأخريين
R_1 =   is the third Resistance
$R_2 + R_3$ مثلا

Alaa Etaiwi