Experiment 3: Network Analysis
The Superposition Principle and Kirchoff's law

- Electric Networks: circuits that include many elements such as: resistors / voltage sources / current sources That are connected together in a Complicated Way

- To Analyse Them you can use :-

Kirchoff's law

loop Theorem :-

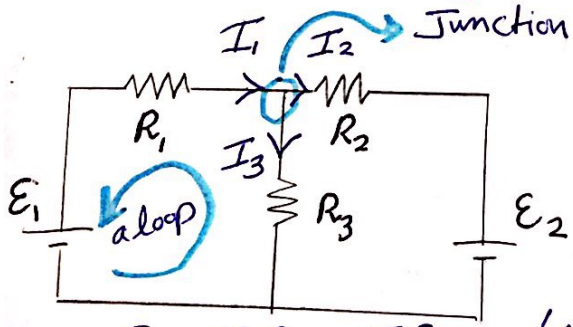
The algebric sum of the voltage drops and $\mathcal{E}$ in a closed circuit $= 0$

- $\sum V_i = 0$
- $\sum_K \mathcal{E}_K = \sum_J I_J R_J$

Junction Theorem

The algebric sum of the currents passing through any circuit Junction $= 0$

$$\sum I_j = 0$$



Junction $I_1 = I_2 + I_3$

Note: If I found negative It's direction must be reversed

$\mathcal{E}_1 = I_1 R_1 + I_3 R_3$ ... (you find other equations To solve & find I)

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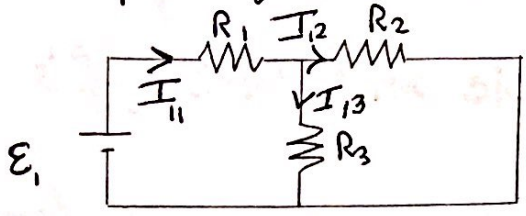
The superposition law

- Any current in a complicated circuit is caused by each source so if we found the current caused by $\mathcal{E}_1$ (for exampl) and sum it with current caused by $\mathcal{E}_2$ we get I_{total}
- we do it in two steps →

Step 1:- find I from first ε :-

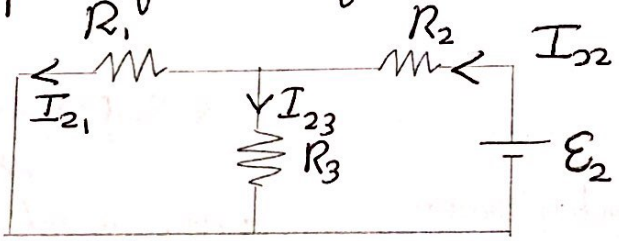


- Now it's not a complicated circuit
we find R total
Then we find I_{11}, I_{12}, I_{13}

- $R_{Total} = R_1 + \frac{(R_2 R_3)}{R_1 + R_3}$
- $I_{11} = \frac{\varepsilon_1}{R_{Tot}}$
- $I_{12} R_2 = I_{11} R_1$
- $I_{13} R_3 = I_{11} R_1$

] Since it's on parallel V is equal for I_{12} & I_{13}

Step 2: find I from second ε :-



- Same as step 1
find R_{tot} and I_{21}, I_{23}, I_{22}

- $R_{tot} = R_2 + \frac{(R_1 R_3)}{R_1 + R_3}$
- $I_{22} = \frac{\varepsilon_2}{R_{tot}}$
- $I_{21} R_1 = I_{22} (R_{tot})$
- $I_{23} R_3 = I_{22} (R_{tot})$

Alaa Hawi

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

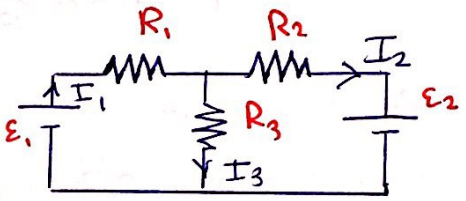
- Procedure :-
  - Kirchoff :-

1- Connect the circuit →

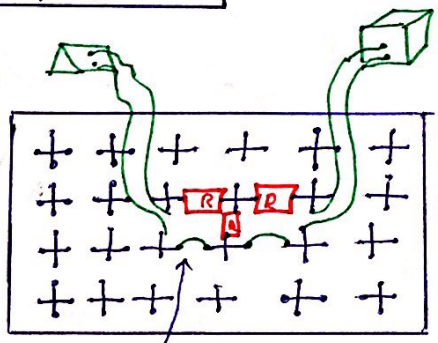
- Remember :-

R_1, R_2 & R_3 are carbon Resistances

ε_1, ε_2 are Voltage sources



2- you put the Ammeter as explained in figures (1-3) to measure I_1, I_2 & I_3



- you put the Digital Multimeter in each Branch to measure I

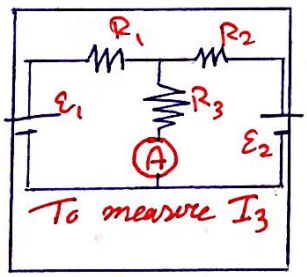


Fig 1

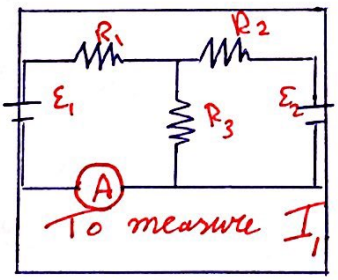


Fig 2

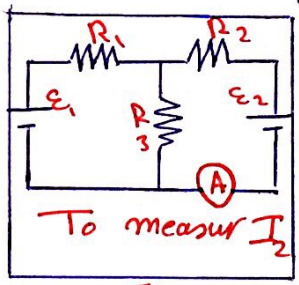


Fig 3

- كيرشوف
- قم بوصل الدارة كما في الشكل الموضح
- ضع الأميتر كما هو موضح لقياس التيارات الثلاث
- تذكر أن R_1, R_2, R_3 هم مقاومات كربونية
  ε_1, ε_2 هي مصادر الجهد

Alaa Khaiwi

Superposition :-

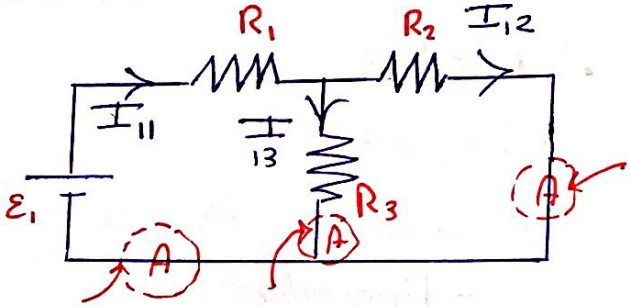
1- We have two Principle steps :-

→ First :-

Taking ε_2 off :-

- So That the New circuit is :-

- Put the Ammeter in each Branch As I explained Previously

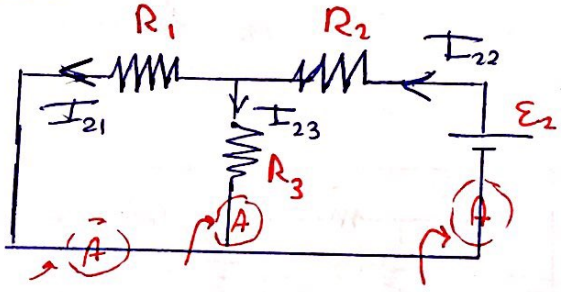


→ Second :-

- Taking ε_1 off :-

- The New circuit is :-

- Put the Ammiter



- Sum up measurement From First & second :-

$I_1 = I_{11} + I_{21}$ $\quad I_3 = I_{13} + I_{23}$

$I_2 = I_{12} + I_{22}$

- هناك خطوتين أساسيتين في هذا الجزء من التجربة :-

الأولى :-

- قم بإزالة ε_2 ثم ضع الـ Ammeter في كل فرع I_{11} ، I_{12} ، I_{13}

الثانية :-

- قم بإزالة ε_1 ثم ضع الـ Ammeter في كل فرع I_{21} ، I_{22} ، I_{23}

ثم جمع الناتج من الخطوة الأولى والثانية للحصول على I_1, I_2, I_3

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