

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

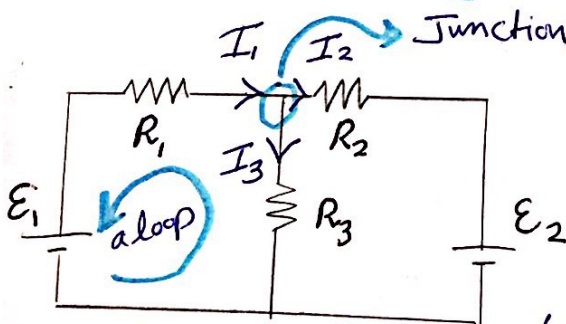
To Analyse them you can use :-

Kirchoff's law

Loop Theorem :-

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

$$\begin{aligned} \bullet \sum V_i &= 0 \\ \rightarrow \sum_k \mathcal{E}_k &= \sum_j I_j R_j \end{aligned}$$



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

Also $\mathcal{E}_2$ is also

Junction Theorem

The algebraic sum of the currents passing through any circuit junction $= 0$

$$\sum I_j = 0$$

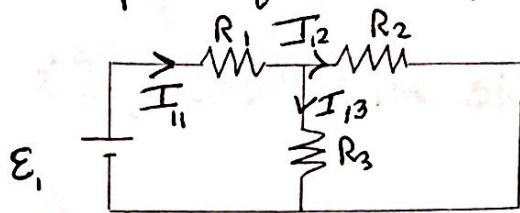
Note: If I found negative it's direction must be reversed

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 example) 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 $\mathcal{E}$:-



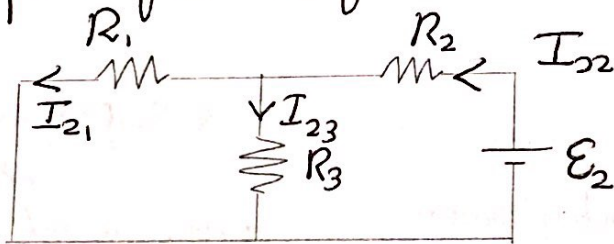
• Now it's not a complicated circuit we find R_{total}
Then we find I_1, I_2, I_3

$$R_{Total} = R_1 + \frac{(R_2 R_3)}{R_2 + R_3}$$

$$I_1 = \frac{\mathcal{E}_1}{R_{Total}}$$

$$\left. \begin{aligned} I_2 R_2 &= I_1 R_1 \\ I_3 R_3 &= I_1 R_1 \end{aligned} \right\} \text{Since it's on parallel } V \text{ is equal for } I_2 \text{ \& } I_3$$

Step 2: find I from second $\mathcal{E}$:-



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

$$R_{tot} = R_2 + \frac{(R_1 R_3)}{R_1 + R_3}$$

$$I_{22} = \frac{\mathcal{E}_2}{R_{tot}}$$

$$I_{21} R_1 = I_{22} (R_{tot})$$

$$I_{23} R_3 = I_{22} (R_{tot})$$

Alaa Etaiwi

• What we use :-

- 2 voltage sources
- 3 carbon Resistances
- Circuit board
- digital Multimeter



• Procedure :-

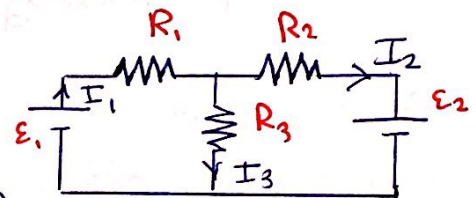
• Kirchhoff :-

1- Connect the circuit $\Rightarrow$

- Remember :-

R_1, R_2 & R_3 are Carbon Resistances

$\mathcal{E}_1, \mathcal{E}_2$ are Voltage sources



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

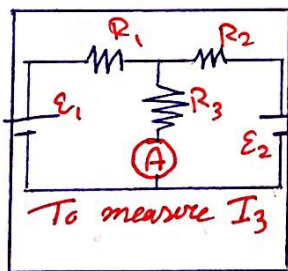


Fig 1

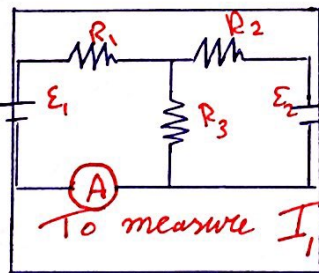


Fig 2

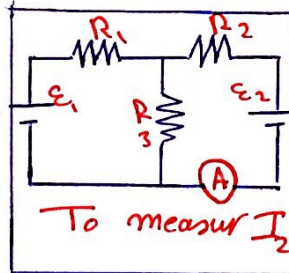
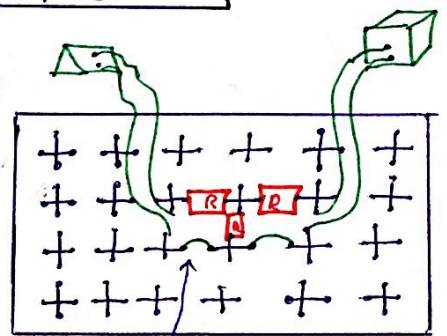


Fig 3



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

• 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

$\mathcal{E}_1$ و $\mathcal{E}_2$ هي مصادر جهد

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Superposition:-

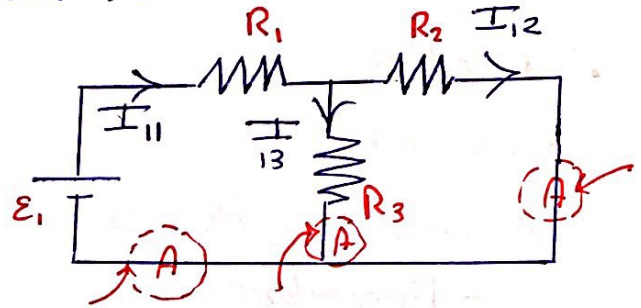
1 - We have two Principle steps:-

→ First:-

Taking $\mathcal{E}_2$ off:-

• So That the New circuit is:-

• Put the Ammeter in each Branch
As I explained previously.



→ Second:-

Taking $\mathcal{E}_1$ off:-

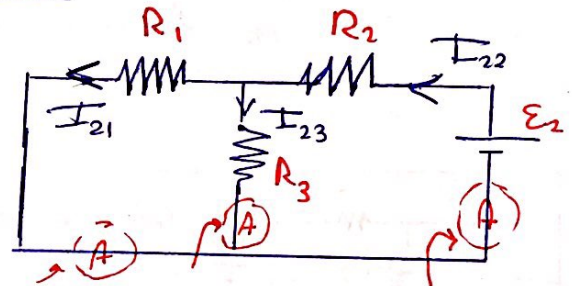
• The New circuit is:-

• Put the Ammeter -

• Sum up measurement

From First & Second:-

$$\begin{aligned} I_1 &= I_{11} + I_{21} \\ I_2 &= I_{12} + I_{22} \\ I_3 &= I_{13} + I_{23} \end{aligned}$$



• هناك خطوات اثنين في هذا الجزء من التجربة:-

الاولى:-

• قم بإزالة $\mathcal{E}_2$ ثم قس I_{11} , I_{12} , I_{13} بوضع الـ Ammeter في كل فرع.

الـ ثانياً:-
• قم بإزالة $\mathcal{E}_1$ ثم قس I_{21} , I_{22} , I_{23} بوضع الـ Ammeter في كل فرع.

• قم بجمع النتائج من الخطوات الأولى والثانية للحصول على I_1, I_2, I_3

Alaa Etaiwi