

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

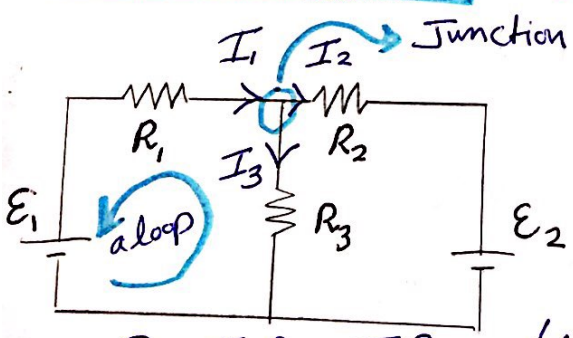
$$\sum V_i = 0$$

$$\rightarrow \sum_k \mathcal{E}_k = \sum_j I_j R_j$$

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

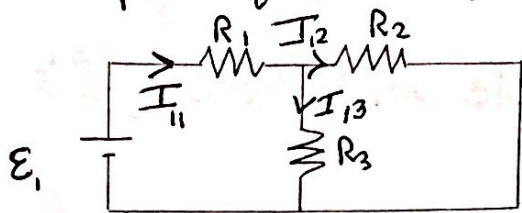
$\mathcal{E}_1 = I_1 R_1 + I_3 R_3$... (you find other equations to solve & find I)
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The superposition law

- Any current in a complicated circuit is caused by each source so if we found the current caused by \mathcal{E}_1 (for 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}



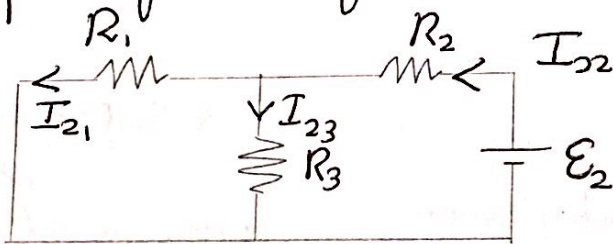
• Now it's not a complicated circuit we find R_{total}
Then we find I_{11}, I_{12}, I_{13}

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

• $I_{11} = \frac{\mathcal{E}_1}{R_{Total}}$

• $I_{12} R_2 = I_{11} R_1$
• $I_{13} R_3 = I_{11} R_1$ } since it's on parallel V is equal for I_{12} & I_{13}

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



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

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

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

• $I_{21} R_1 = I_{22} (R_{total})$

• $I_{23} R_3 = I_{22} (R_{total})$

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



• Procedure :-

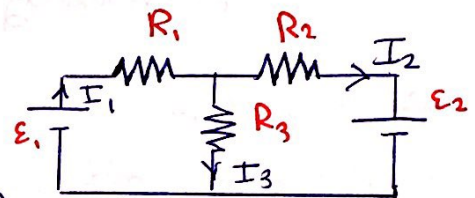
• Kirchoff 1-

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

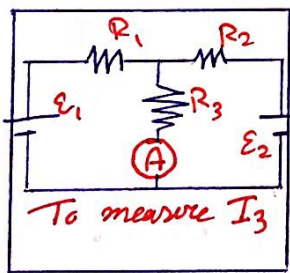
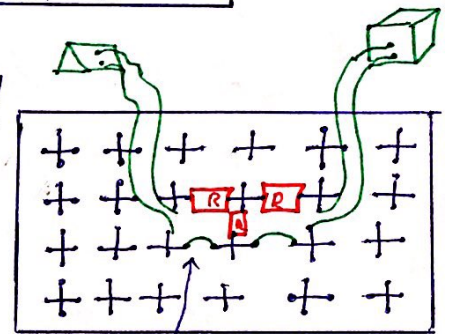


Fig 1

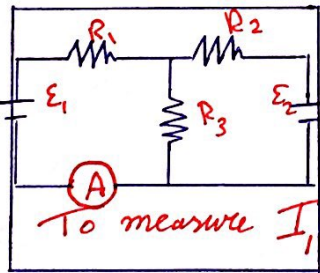


Fig 2

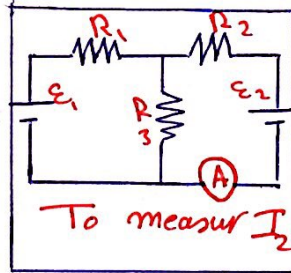


Fig 3

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

• كروتوف

- قم بوصل الدارة كما في الشكل للوضع
- ضع الأميتر كما هو موضح لقياس التيارات التي
- تذكر أن R_1, R_2, R_3 هم مقاومات كربونية
- \mathcal{E}_1 و \mathcal{E}_2 هي مصادر الجهد

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Superposition:-

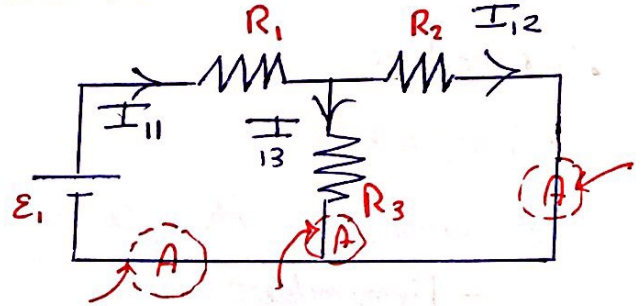
1- We have two Principle steps:-

→ 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 Ammeter -

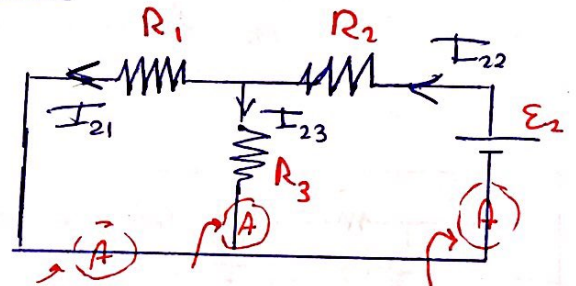
• Sum up measurement

From First & second:-

$$I_1 = I_{11} + I_{21}$$

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

$$I_3 = I_{13} + I_{23}$$



• هناك خطوات اثنين في هذا الجزء من العملية:-

الاولى:-

• قم بإزالة ϵ_2 مع قس I_{11} , I_{12} , I_{13} بوضع الـ Ammeter في كل فرع

الثانية:-
• قم بإزالة ϵ_1 مع قس I_{21} , I_{22} , I_{23} بوضع الـ Ammeter في كل فرع

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

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