Expirament 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 :-
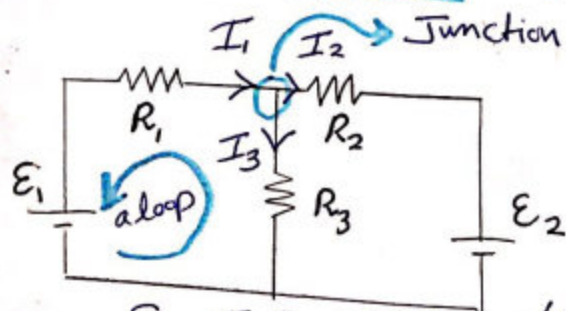The algebric sum of the Voltage drops and ε in a closed circuit $= 0$

- $\sum_i V_i = 0$

- $\sum_k \varepsilon_k = \sum_j I_j R_j$

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

$\sum_j I_j = 0$

$I_1 \rightarrow I_2 \rightarrow$ Junction $I_1 = I_2 + I_3$

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

$\varepsilon_1 = I_1 R_1 + I_3 R_3$ --- (you find other equations To solve & find I)

The superposition law

- Any current in a complicated circuit is caused by each source so if we found the current caused by ε_1 (for exampl) and sum it with current caused by ε_2 we get I_{total}

- we do it in two steps $\longrightarrow$
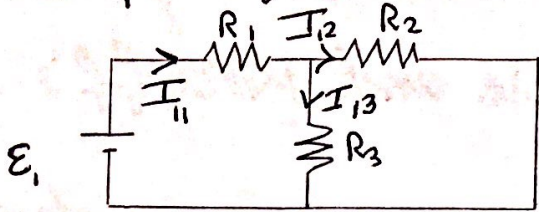
• Now it's not a complicated circuit
we find R total
Then we find I_{11}, I_{12}, I_{13}

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

• $I_{11} = \dfrac{\varepsilon_1}{R_{Tot}}$

• $I_{12} R_2 = I_{11} R_1$

• $I_{13} R_3 = I_{11} R_1$

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

Step 2: find I from second ε :-
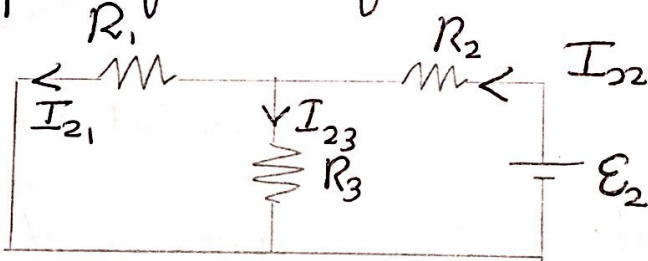
• Same as step 1
find R_{tot} and
I_{21}, I_{23}, I_{22}
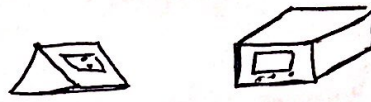
• $R_{tot} = R_2 + \dfrac{(R_1 R_3)}{R_1 + R_3}$

• $I_{22} = \dfrac{\varepsilon_2}{R_{tot}}$

• $I_{21} R_1 = I_{22} (R_{tot})$

• $I_{23} R_3 = I_{22} (R_{tot})$

- what we use :-
  - 2 Voltage sources
  - 3 carbon Resistances
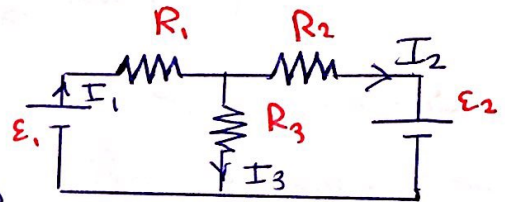 - circuit board
  - digital Multimeter

- Procedure :-

- Kirchoff :-

1- Connect the circuit ⇒

  - Remember :-

    $R_1, R_2 \& R_3$ are Carbon

    Resistances

    , $\varepsilon_1, \varepsilon_2$ are Voltage sources

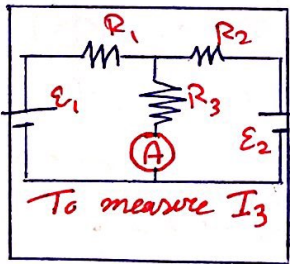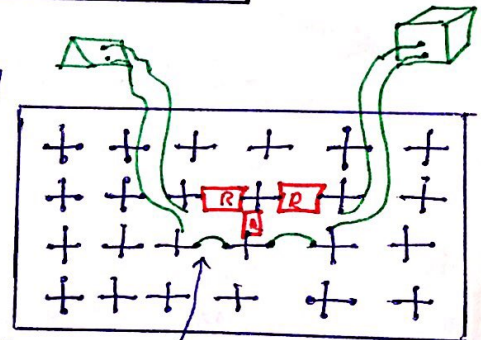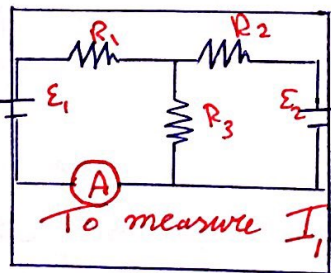2- you put the Ammeter as explained in figures (1-3) to measure
$I_1, I_2 \& I_3$

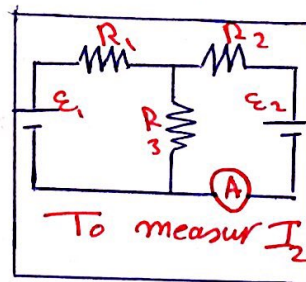- you put the Digital Multimeter in each Branch to measure I

To measure I_3

Fig 1

To measure I_1

Fig 2

To measure I_2

Fig 3

- كيرشوف
- قم بوصل الدائرة كما في الشكل الموضح
- ضع الأميتر كما هو موضح لقياس التيارات الثلاث
↩ تذكر أن R_1, R_2, R_3 هم مقاومات كربونية
$\varepsilon_1, \varepsilon_2$ هي مصادر جهد
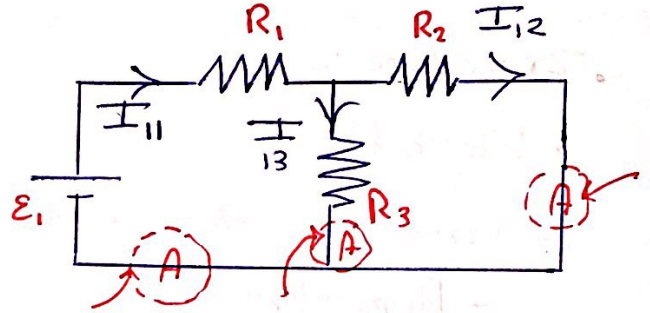
Superposition :-

1- We have two principle steps :-

→ First :-

Taking ε_2 off :-

• So That the New circuit is :-

• Put the Ammeter in each Branch As 1 explained Previously

→ Second :-

Taking ε_1 off :-
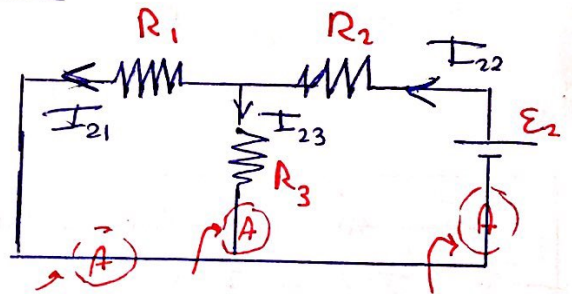
• The New circuit is :-

• 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 خطوتين لحساب في هذا الجزء من التجربة :-

الأولى -1

• قم بإزالة ε_2 ثم قس I_{11} , I_{12} , I_{13} لوضع ال Ammeter في كل فرع

الثانية -

• قم بإزالة ε_1 ثم قس I_{21} , $I_{2,2}$, I_{23} لوضع ال Ammeter في كل فرع

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