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EXPERIMENT : No. 02.

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Date

- **Aim :** To verify Kirchhoff's Current Law & Kirchhoff's Voltage Law.

- **Apparatus :** DC power supply, Ammeter (0-1A), Voltmeter (0-150V), Rheostat, multimeter.

- **Theory :**

KCL states, the algebraic sum of all currents entering ~~and exiting~~ a node must be equal to zero

i.e. $\sum_{i=1}^{n} I_i = 0$ - Eqn 1

I_i - current entering from branch i to a node
Total n branches.

KVL states that the directed sum of the potential difference around any closed loop is zero.

i.e $\sum_{K=1}^{n} V_K$ - Eqn 2

n - total no. of ~~times~~ voltage drop measured.

- **Procedure :**

A. To verify Kirchhoff's ~~Current~~ Law -

1- Connect the circuit as shown in Fig. I
2- Set the values of rheostat to $R_1 = 145\,\Omega$ and $R_2 = 300\,\Omega$ and $R_3 = 145\,\Omega$
3- Connect ammeter in series with each resistor.

Sundaram

Teacher's Sign. : _____

Circuit Diagram

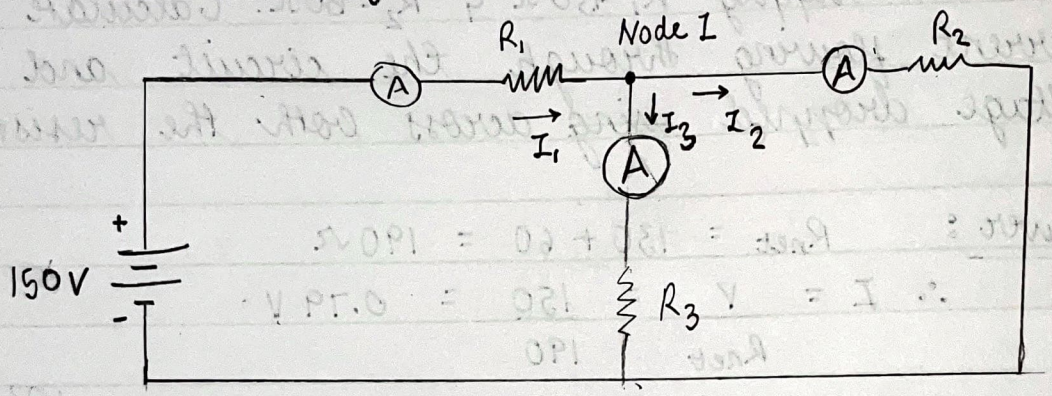

Fig. 1

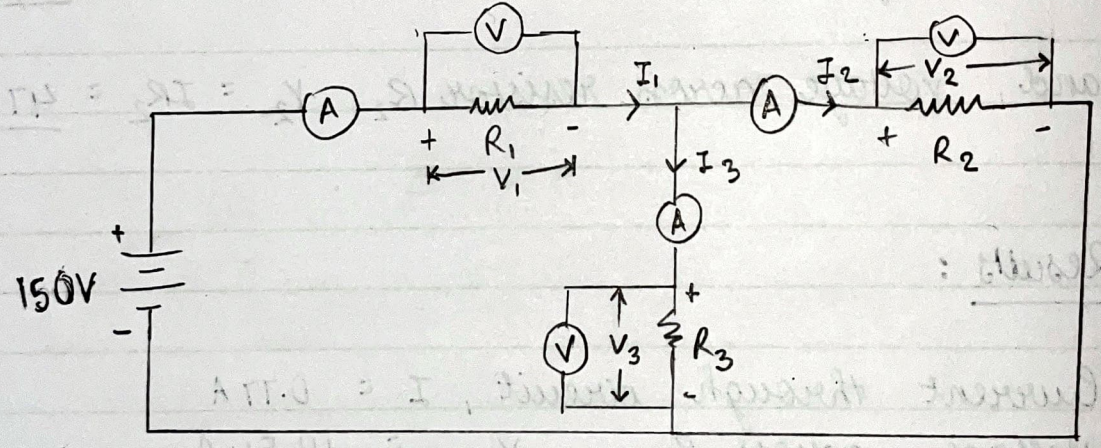

Fig 2

4- Turn ON the DC power supply, measure the supply given to circuit using multimeter and set its value to 156V.

5- Observe the current shown in each ammeter and note it down.

6- Using Eqn 1 verify Kirchhoff's Law.

B To verify Kirchhoff's Voltage Law :

1- Connect the circuit as shown in Fig-2

2- Set the values of rheostat to $R_1 = 145\,\Omega$, $R_2 = 300\,\Omega$ and $R_3 = 145\,\Omega$.

3- Connect voltmeter in parallel with each resistor.

4- Turn ON the DC supply, measure the supply given to circuit using Multimeter and set its value to 156 V.

5- Observe the current shown in each voltmeter and note it down.

6- Using Eqn 2 verify Kirchhoff's Voltage Law.

• Questions :

1) For a resistive circuit as shown in Fig. 1 with 150V DC supply, $R_1 = 100\,\Omega$ and $R_2 = 200\,\Omega$ and $R_3 = 150\,\Omega$. Calculate the current flowing through each resistor and verify KCL at Node 1.

2) For a resistive circuit as shown in Fig. 2

Observation Table :

$R_1 = 145\,\Omega$ $R_2 = 300\,\Omega$
$R_3 = 145\,\Omega$ $V = 156\,V$

Current through Resistors	Observed Values	Calculated Values
I_1	0.65 A	0.64 A
I_2	0.21 A	0.21 A
I_3	0.45 A	0.43 A

Voltage across Resistors	Observed Values	Calculated Values
V_1	93 V	92.8 V
V_2	62 V	63 V
V_3	62 V	63 V

Calculations :

From KCL

$$I_1 = I_2 + I_3$$

$$I_1 = \frac{V}{R_1 + \frac{R_2 R_3}{R_2 + R_3}} = 0.64\,A$$

$$I_2 = \frac{145}{445} \times 0.64 = 0.21\,A$$

$$\therefore I_3 = \frac{300}{445} \times 0.64 = 0.43\,A$$

[observed values] Verification

$\rightarrow$ $0.21 + 0.45 = 0.66 \approx 0.65$ [KCL]

[KVL] $\rightarrow$ $93 + 62 = 155 \approx 156\,V$

From KVL, $V_1 + V_2 = 156\,V$

$V_1 = I_1 R_1 = 92.8\,V$

$V_2 = I_2 R_2 = 63\,V$

$V_3 = I_3 R_3 = 63\,V$

Calculations Q1 -

$R_1 = 100\,\Omega$, $R_2 = 200\,\Omega$ $R_3 = 150\,\Omega$, $V = 150\,V$

$R_{net} = 100 + \frac{(200)(150)}{350} = \underline{185.71\,\Omega}$

$\therefore I_1 = \frac{150}{185.71} = \underline{0.81\,A}$ $\therefore I_2 = \frac{3}{7}(0.81) = \underline{0.35\,A}$

$I_3 = \frac{4}{7}(0.81) = \underline{0.46\,A}$ $\therefore$ At Node I

$I_1 = 0.81 \Rightarrow I_2 + I_3 = \underline{0.81\,A}$

KCL verified

Calculation Q2 -

$R_1 = 100\,\Omega$, $R_2 = 200\,\Omega$, $R_3 = 150\,\Omega$, $V = 150\,V$

$V_1 = I_1 R_1 = 0.81 \times (100)$
$= \underline{81\,V}$

$V_2 = I_2 R_2 = \underline{70\,V}$

$V_3 = I_3 R_3 = 0.46\,(150)$
$= \underline{69\,V}$

$V = V_1 + V_2$
$(V_2 \approx V_3)$

with 150 V DC supply, $R_1 = 100\Omega$, $R_2 = 200\Omega$ & $R_3 = 150\Omega$. Calculate the voltage across each resistor and verify KVL.

- **Results :**

A.1 $I_1 = 0.81A$, $I_2 = 0.35A$, $I_3 = 0.46A$
$\therefore$ In KCL LHS = RHS $\therefore$ Verified

A.2. $I_1 \rightarrow V_1 = 81V$, $V_2 = 70V$, $V_3 = 69V$ [Ignoring calc. approximations]
$\therefore$ In KCL LHS = RHS Verified

- **Conclusions :**

1. Kirchhoff's Current & Voltage Laws are verified for an electric circuit.
2. Minor calculations, or instrumental errors are ignored. (approximations)
3. Instrumental errors are possible due resistance of the ammeter & voltmeter & also of the wires.