Circuits and Electronics

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Course Code: CSE250

Section : 14

Experiment no: 03

Experiment Name: Verification of KCL and KVL

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Name of the Experiment:

Verification of KCL and KVL.

KVL

Objective:

This experiment is intended to verify Kirchhoff's voltage Law (KVL) with the help of series circuits.

Apparatus:

1. One DC Ammeter (0 – 1 A)
2. One multimeter
3. Three Resistors
4. One DC power supply

Circuit/Block/ System Diagram:

$V_A = 15.0\ V$

$R_1 = 1.0\ K\Omega$

$R_2 = 9.5\ K\Omega$

$R_3 = 1.5\ K\Omega$

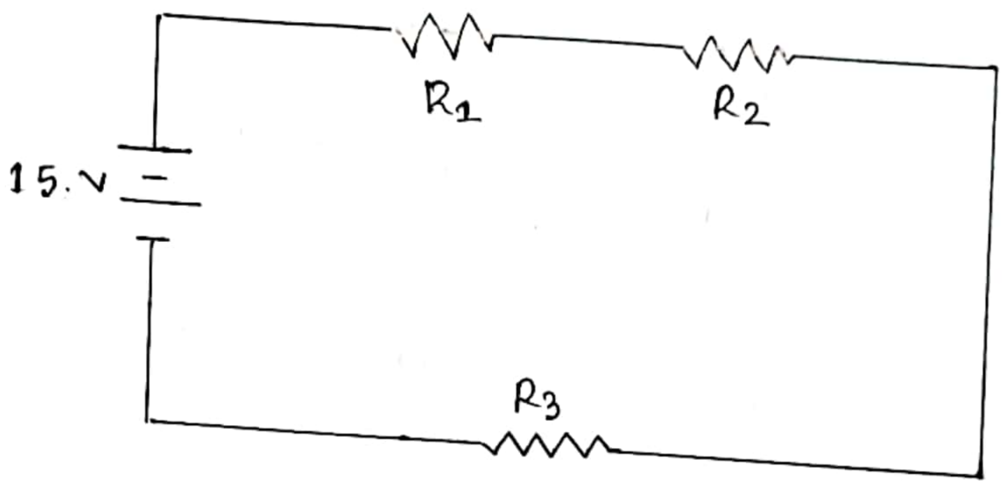


Fig-1

Result/Analysis:

$$R_e = R_1 + R_2 + R_3$$
$$= (1 + 9.5 + 1.5) K\Omega$$
$$= 12 K\Omega$$

$$\therefore V_1 = \left(\frac{R_1}{R_e}\right) V$$
$$= \frac{1 \times 10^3}{12 \times 10^3} \times 15$$
$$= 1.25$$

$$V_2 = \left(\frac{R_2}{R_e}\right) V$$
$$= \frac{10^3 \times 9.5}{10^3 \times 12} \times 15$$
$$= 11.875 \text{ V}$$

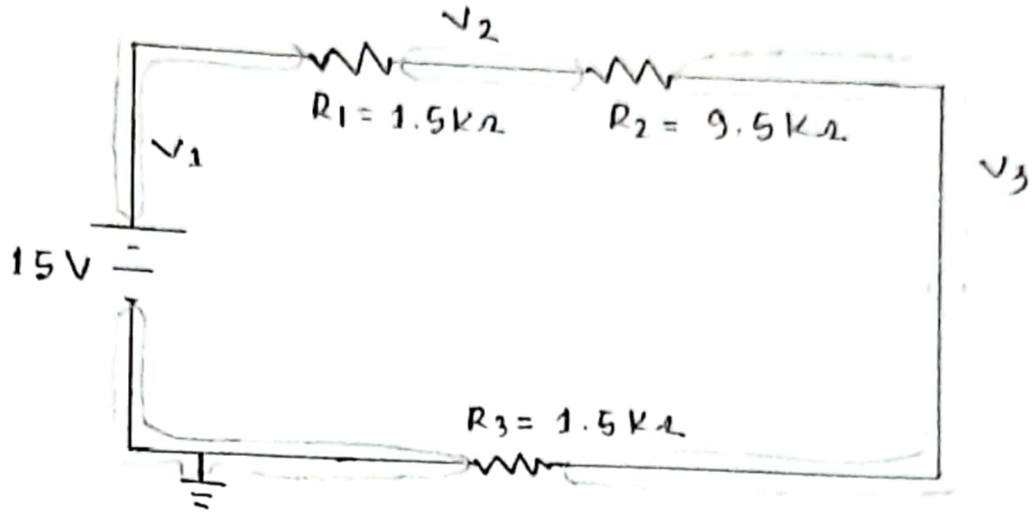
$$V_3 = \left(\frac{R_3}{R_e}\right) V$$
$$= \frac{10^3 \times 1.5}{10^3 \times 12} \times 15$$
$$= 1.875 \text{ V}$$

To verify the KVL as $V_s = V_1 + V_2 + V_3$

$$\therefore V_s = V_1 + V_2 + V_3$$
$$= 1.25 + 11.875 + 1.875$$
$$= 15 V$$
$$= V_s$$

Result / Analysis:

For Fig-1:



Node 1:

$$V_1 - 0 = 15V$$

$$\Rightarrow V_1 = 15V \text{ ---- } (i)$$

Node 2:

$$V_2 \left(\frac{1}{R_1} + \right. \frac{V_1}{R_1} - \frac{V_3}{R_2} = 0$$

$$\Rightarrow V_2\left(\frac{1}{1} + \frac{1}{9.5}\right) - \frac{V_1}{1} - \frac{V_3}{9.5} = 0 \text{ ---- } (ii)$$

Node 3:

$$V_3\left(\frac{1}{R_2} + \frac{1}{R_3}\right) - \frac{V_2}{R_2} - \frac{V_3}{R_3} = 0$$

$$\Rightarrow V_3\left(\frac{1}{9.5} + \frac{1}{1.5}\right) - \frac{V_2}{9.5} - \frac{V_3}{1.5} = 0 \text{ ---- } (iii)$$

a

After calculating the values.
we get,

$V_1 = 15V$

$V_2 = 13.75$

$V_3 = 1.875$

$\therefore$ To verify the KVL as $V_s = V_1 + V_2 + V_3$:

The voltage accross the R_1,

$V_1 = (15 - 13.75) = 1.25V$

The voltage accross R_2,

$V_2 = (13.75 - 1.875) = 11.875V$

The voltage accross the R_3,

$V_3 = (1.875 - 0) = 1.875V$

$\therefore V_s = V_1 + V_2 + V_3$

$= 1.25 + 11.875 + 1.875$

$= 15V$

$= V_s$

Table 1: Verification of KVL

Observation	Simulation	Theoretical
R_1 (kΩ)	1.0	1.0
R_2 (kΩ)	9.5	9.5
R_3 (kΩ)	1.5	1.5
V_A (V)	15.0	15.0
V_1 (V)	1.25	1.25
V_2 (V)	11.875	11.875
V_3 (V)	1.875	1.875

Questions and Answers:

1. State the rules of connecting voltmeter and ammeter in the circuit.

Answer:

The voltmeter is a meter which

measure the voltage of a electric circuit. It measures the difference of electric potentials between two points of an electric circuit. To measure the electric potentials, the circuit must be connected in parallel device because objects in parallel circuit experience the same potential difference.

Ammeter:

The ammeter is used to measure the current in a circuit. To measure the current of a circuit, it should be connected in series because objects in series connection experience the same current in the whole circuit.

2. Comment on the result obtained and discrepancies (if any).

Answer:

From the simulation value and the theoretical value, there is no discrepancies in the output.

KCL

Objective:

This experiment is intended to verify Kirchhof's current law (KCL) with the help of a simple parallel circuit.

Apparatus:

One DC Ammeter (0-1A)

Three resistors

One multimeter

One DC supply

Circuit / Block / System Diagram:

Here,

$V_A = 6.0\,V$

$R_1 = 4.0\,K\Omega$

$R_2 = 8.5\,K\Omega$

$R_3 = 5.5\,K\Omega$

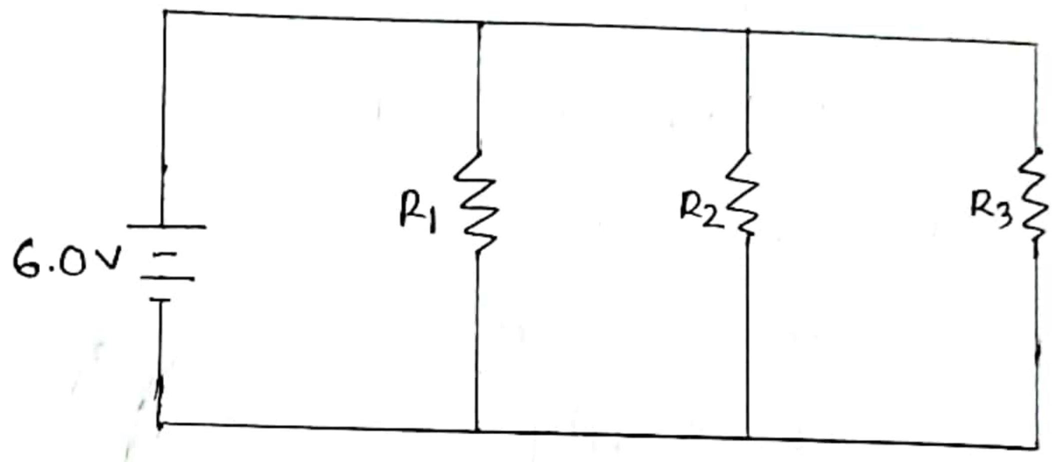


Fig - 2

Result / Analysis:

$$I_1 = \frac{V}{R_1}$$

$$= \frac{6.0}{4.0 \times 10^3}$$

$$= 1.5\,mA$$

$$I_2 = \frac{V}{R_2}$$

$$= \frac{6}{8.5 \times 10^3} = 705.88\,uA$$

$$I_3 = \frac{V}{R_3}$$

$$= \frac{6}{5.5 \times 10^3} = 1.091\,mA$$

$$\therefore I_s = I_1 + I_2 + I_3$$

$$= \{1.5 + (705.88 \times 10^{-3}) + 1.091\}\,mA$$

$$= 3.297\,mA$$

$$V_s = I_1 R_1$$

$$= (4.0 \times 10^3 \times 1.5 \times 10^{-3})$$

$$= 6\,V$$

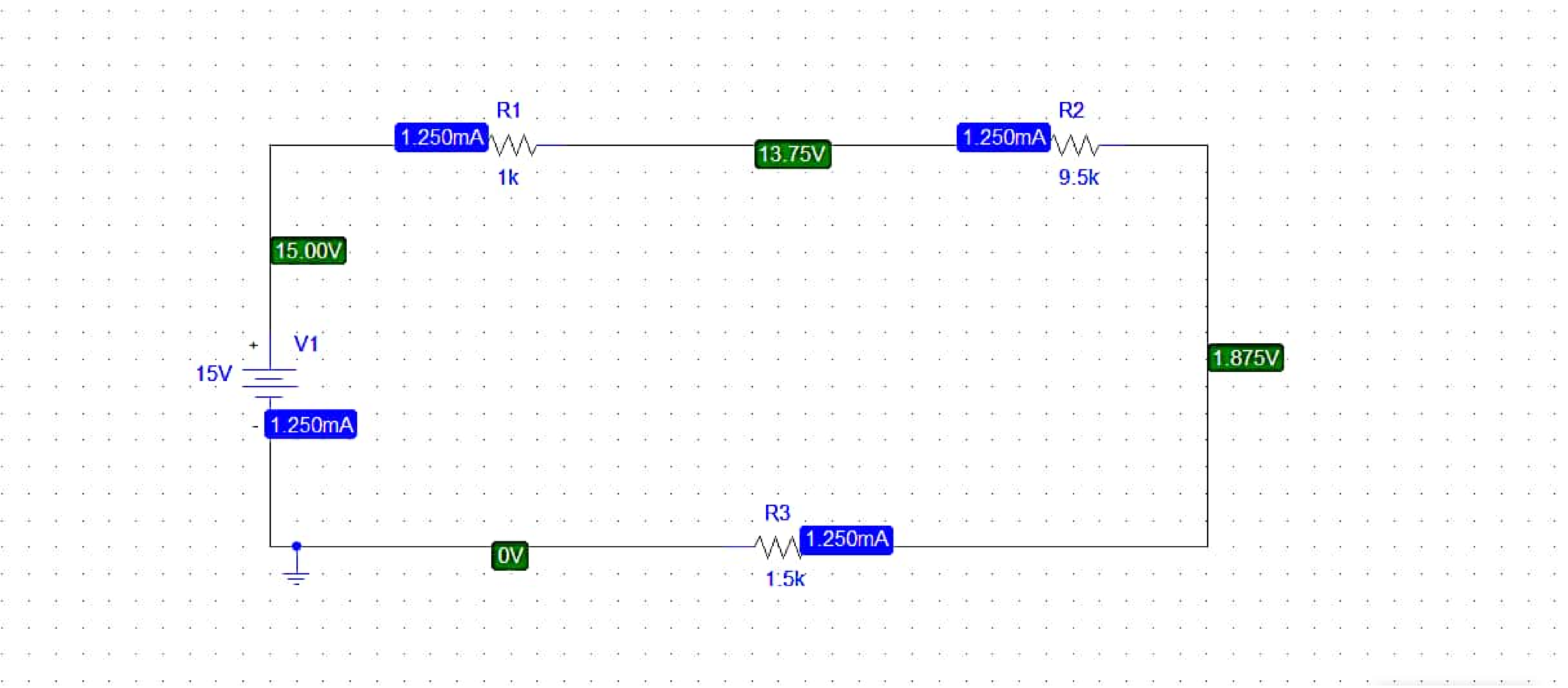
5) Verification of KCL

Observation	Simulation	Theoretical
$R_1 (K\Omega)$	4.0	4.0
$R_2 (K\Omega)$	8.5	8.5
$R_3 (K\Omega)$	5.5	5.5
I (mA)		3.297
I_1 (mA)	1.5	1.5
I_2 (mA)	705.88×10^{-3}	705.88×10^{-3}
I_3 (mA)	1.091	1.091
$I_1 + I_2 + I_3$ (mA)	3.297	3.297

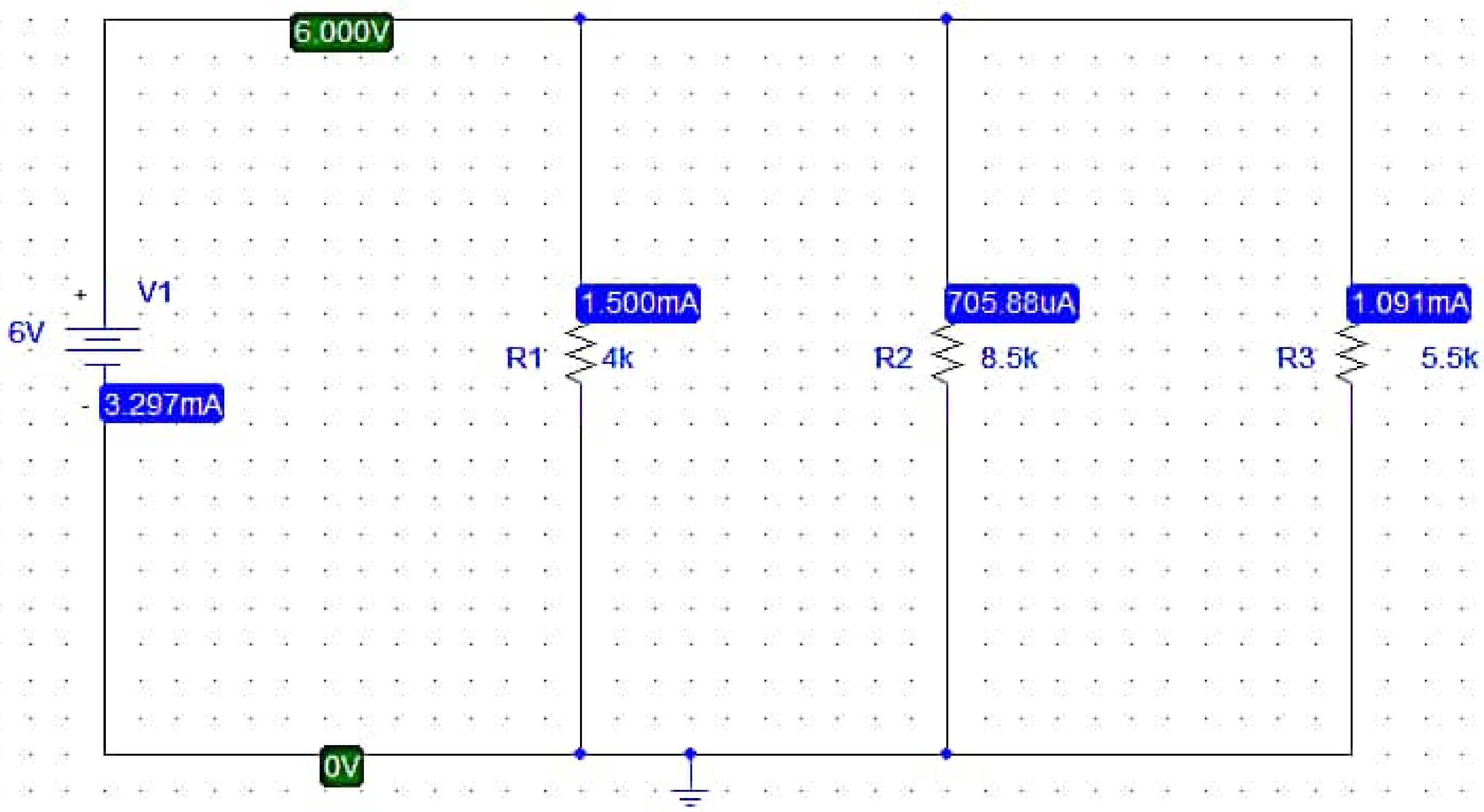
Questions and Answers:

1. Comment on the obtained results and discrepancies (if any).

Answer:
From the simulation value and the theoretical value, there is no discrepancies in the output.



R1
1.250mA
1k
13.75V
R2
1.250mA
9.5k
15.00V
V1
15V
1.250mA
1.875V
R3
1.250mA
0V
1.5k


6.000V
V1
6V
3.297mA
1.500mA
R1
4k
705.88uA
R2
8.5k
1.091mA
R3
5.5k
0V