BIRZEIT UNIVERSITY

Faculty of engineering and Technology

Department of electrical and computer Engineering

Basic Electrical Engineering Lab [ENEE2101]

Report of Experiment 3

"Simple Resistive Circuits"

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Section: 1

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1. Abstract

This experiment was the first experiment in ENEE2101 lab, It was to introduce the methods of use, and some scientific laws such as the KVL, KCL, the voltage divider, and the current divider rules. Also, the effects of the short and open resistors circuits were examined.

2. Theory

In this experiment we set out to verify several laws that are a common standard in the procedure of network analysis, they are Kirchhoff's Voltage Law, Kirchhoff's Current Law, The Voltage Divider Rule, and The Current Divider Rule.

- **Kirchhoff's Voltage Law:** The sum of the efforts from a point and back to the same point (closed mesh or loop) equals zero.

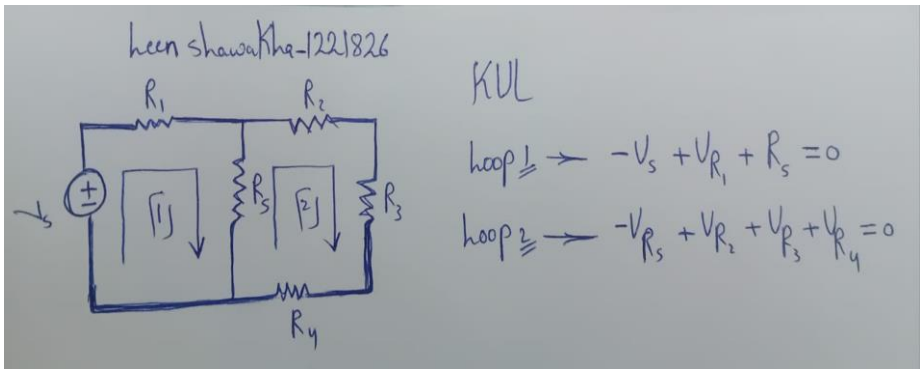

Figure 1

- **Kirchhoff's Current Law**: The sum of the incoming currents equals the sum of the outgoing currents.

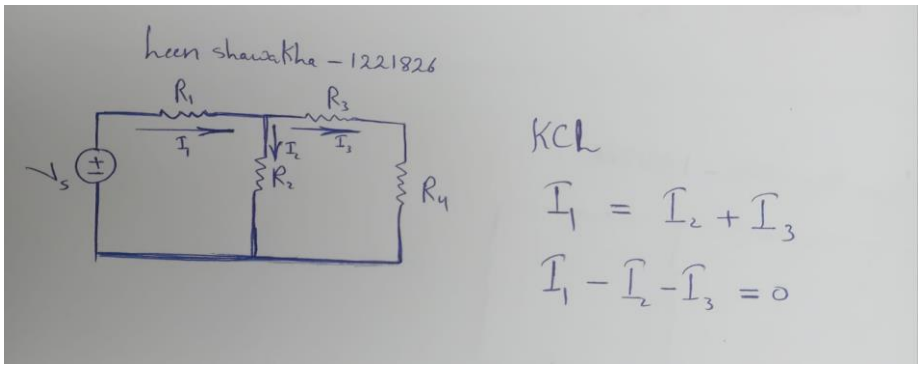

Figure 2

- **The Voltage-Divider rule:** Calculate the voltage across a given resistor connected in series with the circuit potential difference

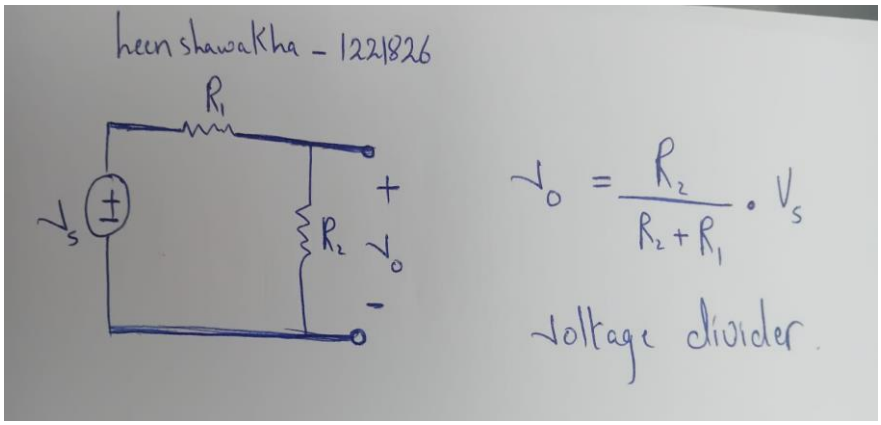

Figure 3

- **The Current-Divider rule:** Calculating the current for a given resistor connected in parallel with the potential difference

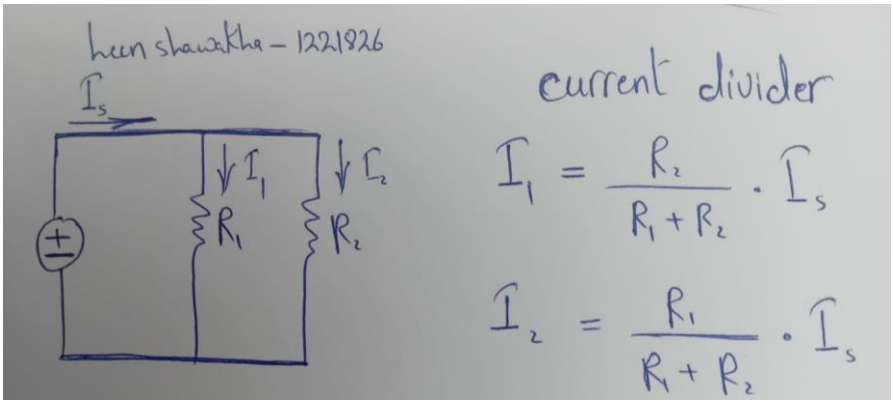

Figure 4

3. Procedure

3.1 Part A: Kirchhoff's Law

Connect the circuit below first

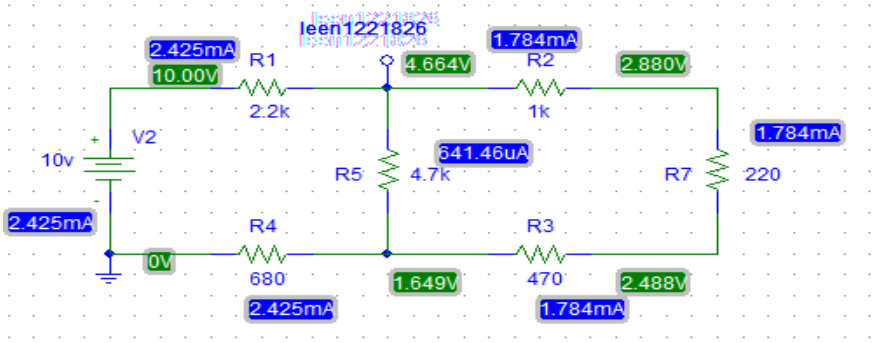

Figure 5

Then the digital multimeter was used to measure the voltage drop across each resistor and the current through each resistor also, but when the voltage was measured the digital multimeter was parallel to the resistor, and when the current was measured, we put it in series with the resistor, and then the data was written in the table1.

Table 1: Voltages and currents for circuit of figure 4

	2.2k	680ohm	4.7k	1k	470ohm	220ohm
Voltage [v]	5.383	1.642	3.047	1.799	0.848	0.393
Current [mA]	2.49	2.52	0.67	1.85	1.85	1.85

3.2 Part B: Voltage Divider

Connect the circuit in the figure

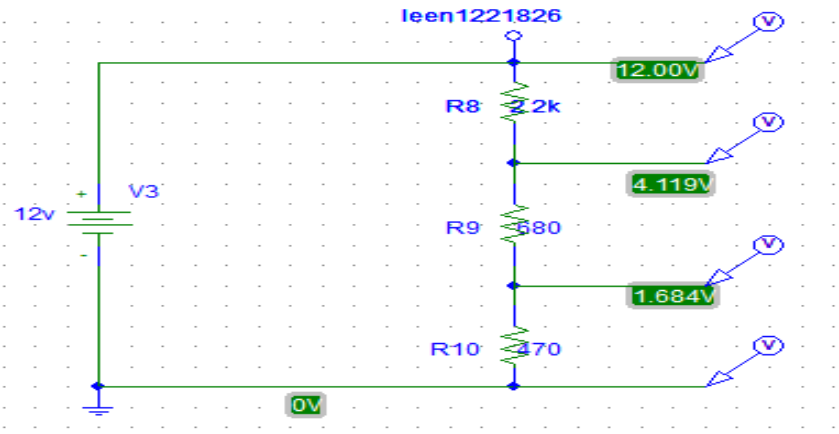

Figure 6: (a) A voltage -divider circuit and (b) the voltage -divider current I indicated.

This circuit used to verify the voltage divider rule Then the power supply was used to put an output voltage equal to 12V and measure the voltage drop between 1-2 and 2-3 and 3-0 terminals by digital multimeter parallel to each terminal.

Table 2

Voltage	V (1-2)	V (2-3)	V (3-0)
	7.96	2.43	1.70

Also, the circuit below was connected in this part

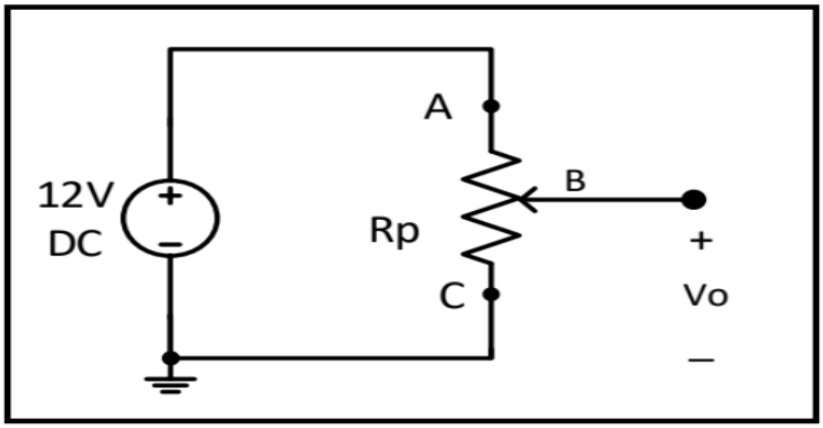

Figure 7: A voltage divider connected to a load RL.

Where Rp is a potentiometer (three-terminal resistor) two terminals have a constant voltage (ab), and the non-constant terminals (bc) were changed until Vo was 3V.

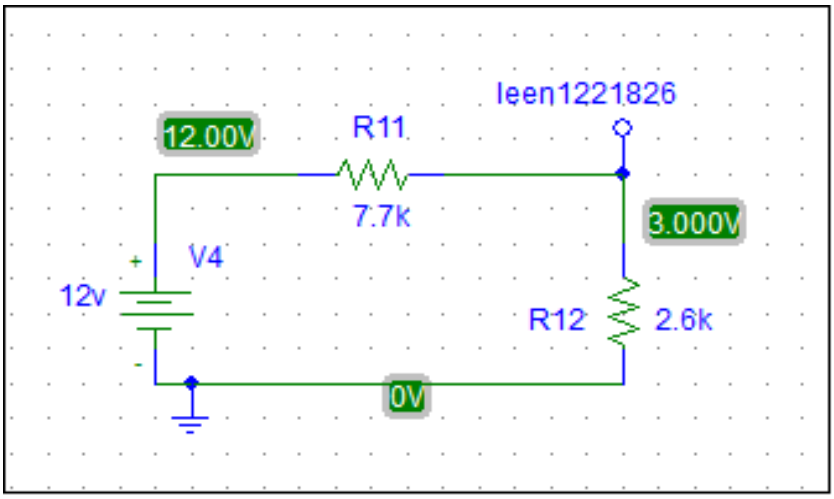

Table 3: Potentiometer values

R(AB)	R(BC)
7.66k	2.63k

Also, the circuit below was connected

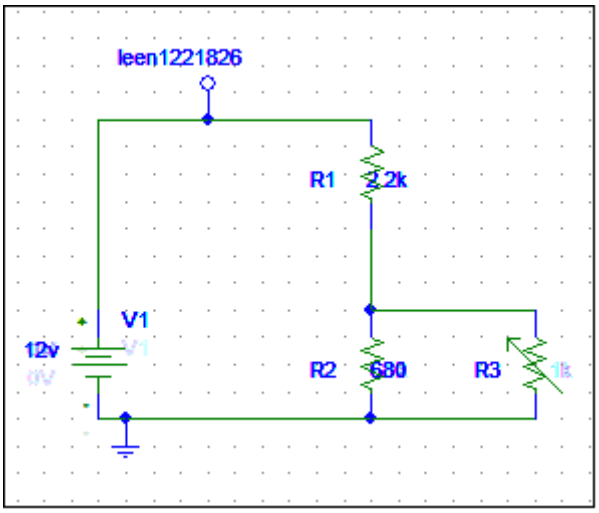

Figure 8

Then Vo was measured by DDM in parallel with RL for different values (1k, 10k, 100k, 500k, and infinity) ohms and the result was written in the table.

Table 4: Voltage measurements as the resistance change from 1K to ∞.

RL	Open circuit	500k	100k	10k	1k
V	2.83	2.83	2.81	2.69	1.96

3.3 Part C: current divider.

The circuit of figure was connected

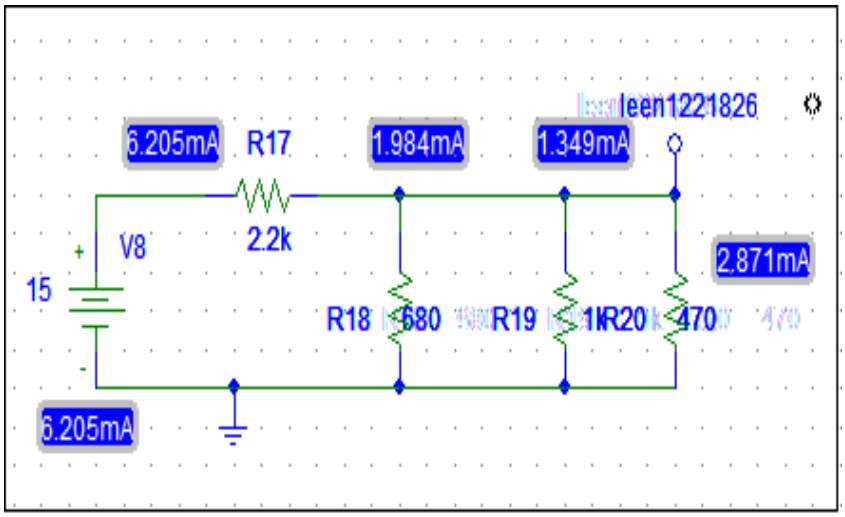

Figure 9

Then Is,I1,I23, I2, and I3 were measured by multimeter and placed in table.

Table 5

Is	I1	I2	I3	I23
6.92	2.02	1.36	2.87	4.23

3.4 Part D: Short-and-Open Circuited Resistor in Series-Parallel Circuits.

1. The circuit of figure 10 was connected and Vin was 12V

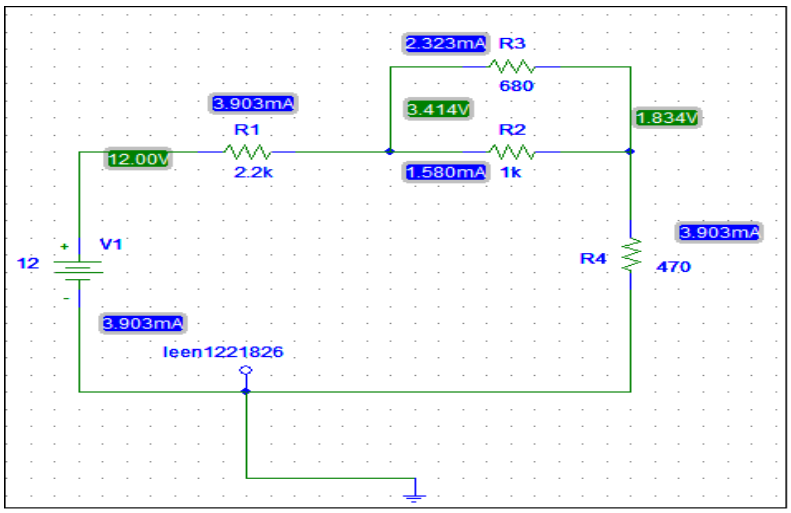

Figure 10

2. voltages V1-2, V2-3, V3-0 & the currents I1, I2 & I3 were measured using a digital multimeter and then recorded data in Table.

3. R1 was replaced by a Short Circuit then we measured the voltages V1-2, V2-3, V3-0 & the currents I1, I2 & I3 using a digital multimeter and then we recorded our data in Table.

4. R1 was reinserted back in the circuit then R2 was replaced by a Short Circuit. After the measurements which has been done in step (3) was repeated, then it was recorded in Table.

Table 6: Short circuit with R1, R2 and R3.

	Normal	R1 SC	R2 SC
I1	14.10	14.10	4.66
I2	1.63	5.69	4.57
I3	2.41	8.45	0
V1-2	8.79	0	10.12
V2-3	1.67	5.65	0
V3-0	1.88	6.64	2.17

5. The circuit has been reset to its original state in Figure 3.9, R1 was removed. The new voltages V1-2, V2-3, V3-0 and the current I1 were measured by a multimeter. After that, the data was recorded in Table.

6. R1 was returned Back in its original place on the circuit, then R2 was removed and the measurements which has been done in step in step (5). After that the data was recorded in Table .

Table 7: Open Circuit with R1, R2 and R3

	R1 OC	R2 OC
V1-2	12.3	8.11
V2-3	0	2.48
V3-0	0	1.73
I1	14.13	3.73

4. Calculation, and Analysis of results

Questions 1

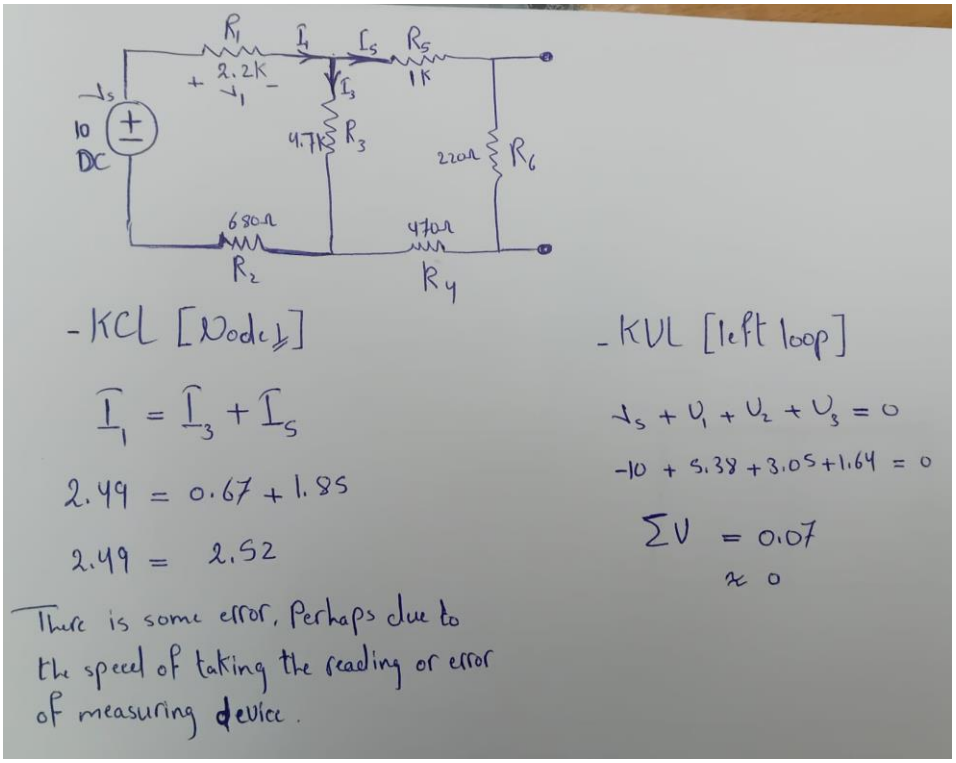

Figure 11

Question 2: The largest voltage drop occurs around the largest resistor (2.2k ohms) because the current is equal in the three resistors, so the largest voltage drop is in the largest resistor, vice versa according to Ohm's law V=IR.

Question 3: V1-2+V2-3+V3-0 = 7.96+2.43+1.70= 12.09 V, So it's not equally 12V because of the error of the measuring device.

Question 4: when the increases from 1k ohm to infinity, the voltage drop will increase also, according to V=IR.

Question 5: From the measured values, the largest current passes through resistor R3 because it is the smallest resistance, The smallest current passes through resistance R0[6.92-2.02=4.9] because it is the largest resistance according to the relationship I=V/R

Question 6: Is = I1+I2+I3 ? 2.02+1.36+2.87 = 6.25A, So it's not equal to Is but it's so close.

Question 7: The voltage of a short circuit is zero, and when the circuit is open no current flow.

5. Conclusion

in conclusion, the experiment focused on understanding and practically connecting a simple resistive circuit. The application and verification of Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL) were explored, alongside the use of voltage and current divider rules. The primary objective of the experiment was to learn how to measure voltages and currents using various techniques.

6. References

[1] Electrical and Computer Engineering Department, circuit lab manual, 2022, pp.42-48