



North South University
Department of Electrical & Computer Engineering

LAB REPORT

Course Name: EEE141L

Section: 08

Lab No: 01

Experiment Number: 01 & 02

Lab Name: Ohm's Law, KVL, and Voltage Divider Rule using Series Circuit

Experiment 01 Name: Verification of Ohm's Law

Experiment 02 Name: Series Circuit

Experiment Date: 12 June, 2022 and 19 June, 2022

Report Submission Date: 26 June, 2022

Group Number: 04

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Remarks:	

Experiment Name:

Verification of Ohm's Law

Objective:

- (1) We have to find the resistance of a resistor from its color code.
- (2) We have to measure voltage, current and resistance values using a digital Multimeter.
- (3) We have to verify the validity of Ohm's Law.
- (4) We have to test the voltage divider rule in a series circuit.

List of Equipment:

- (1) Bread Board
- (2) DC power source
- (3) Resistors ($3.3K\Omega$, $5.6K\Omega$)
- (4) Digital Multimeter (DMM)
- (5) Connecting wire.

Theory:

Ohm's law states that the electrical current flowing through any conductor is directly proportional to the potential difference between its ends, assuming the physical conditions of the conductor do not change. In other words, the ratio of potential difference between any two points of a conductor to the current flowing between them is constant, provided the physical conditions don't change. Mathematically, Ohm's law can be expressed,

$$I \propto V$$

which with the constant of proportionality, the resistance R in the above equation,

$$I = \frac{V}{R}$$

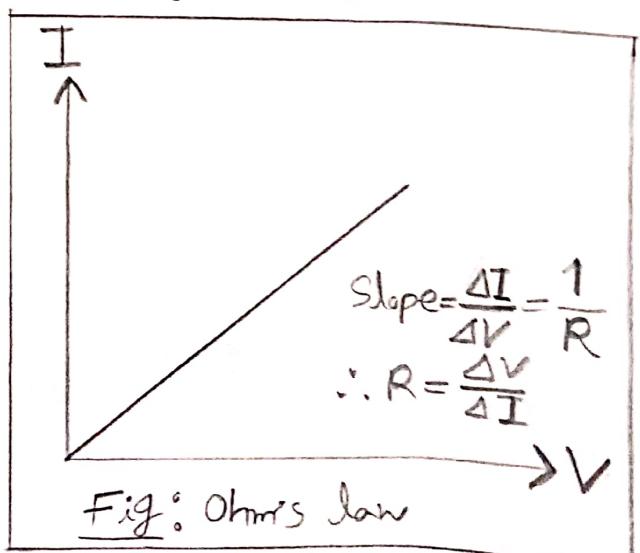
$$\text{or, } V = IR$$

Here,

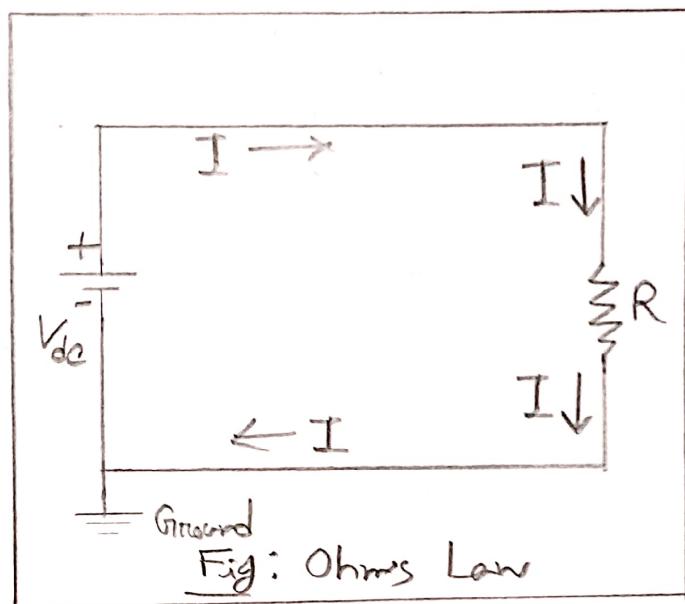
V = voltage

I = current

R = resistance

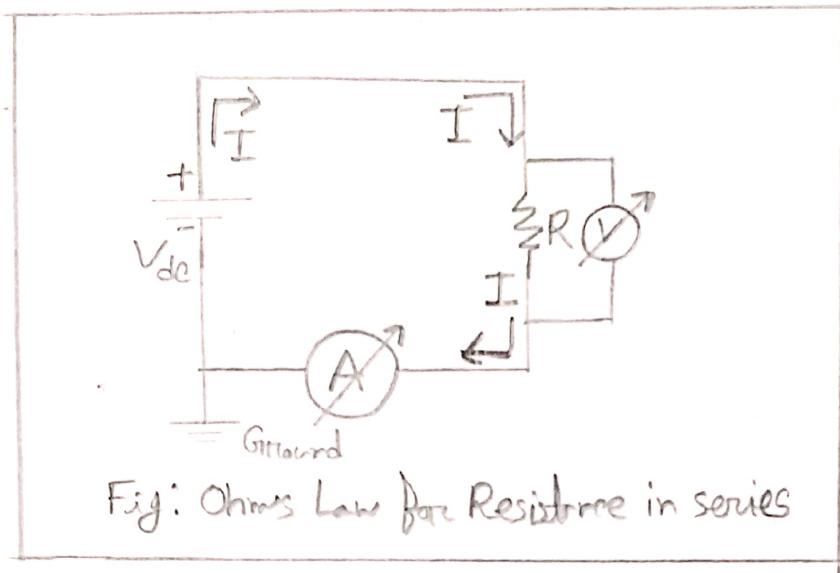


Ohms law can be verified if we manage to show that for a given conductor the ratio of voltage and current is constant. Resistance of the conductor is a constant for a known temperature range.



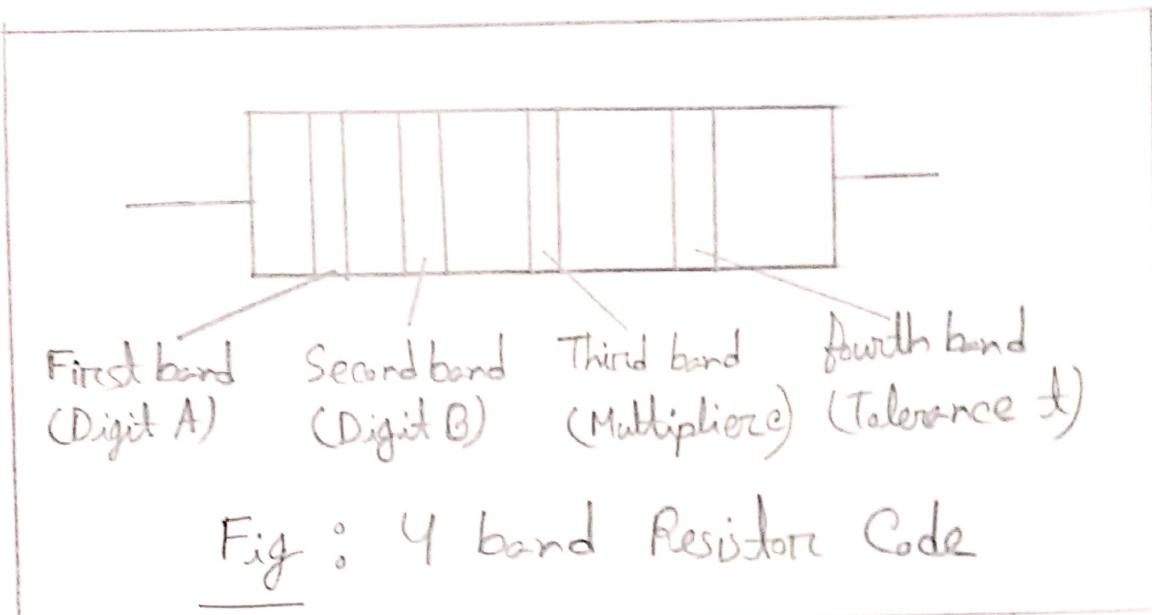
Ohm's law for resistance in series circuits, are sometimes called current-coupled or daisy chain-coupled. The current in a series circuit goes through every component in the circuit. Therefore all of the components in a series connection carry the same current. There is only one path in a series circuit in which the current

can flow.



Resistor value, tolerance and voltage rating are generally printed onto the body of the resistor as number or letters when the resistor body is big enough to read the print, such as large power resistors. But when the resistor is small such as a 1/4 watt carbon or film type, these specifications must be shown in some other manner as the print would be too small to read. So, The values are often indicated with color codes. The Coding is defined in the

international standard IEC 60062.



In the figure, there are four colors and each color represents a number in the 4 band resistor. The order in which the colors are arranged, gives the values of resistor.

∴ Theoretical Resistance :

First band Second band (\times Third band) \pm Fourth band

$$= \text{Digit}(A) \text{ Digit}(B) (\times \text{Multiplier}(C)) \pm \text{Tolerance}(t)$$

We can measure resistance theoretically by using Ohms law,

$$\text{which is } V = IR \text{ or, } R = \frac{V}{I}$$

we can also calculate from power, which is.
 $P = VI = (IR)I = I^2R$ or, $P = I^2R$ or, $R = \frac{P}{I^2}$

Percentage error is the difference between approximate and exact value, as a percentage of the exact value. In other words, it is the difference between estimated value and the actual value in comparison to the actual value and is expressed as a percentage.

$$\therefore \text{Percentage error} = \frac{|\text{Practical value} - \text{Theoretical value}|}{\text{Theoretical value}} \times 100$$

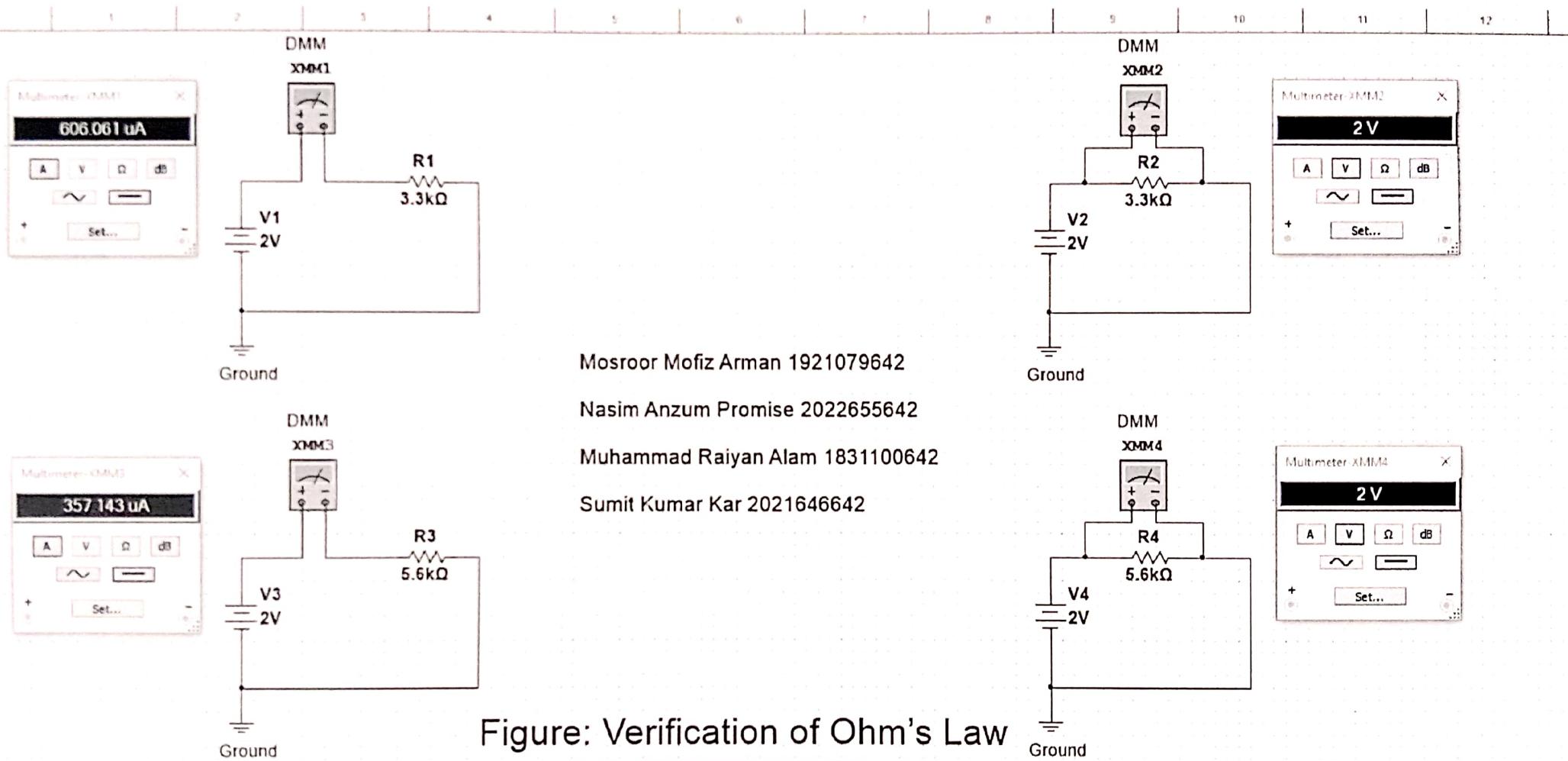


Figure: Verification of Ohm's Law

North South University



Department of Electrical & Computer Engineering

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Data Collection for Exp1:

Lab 1: Exp1

Group No. 4

Instructor's Signature Wazid

Please do all the calculations in 3 significant figures or 2 decimal places where applicable

Table 1:

Resistance using colour coding					Resistance using DMM	% Error
Band 1	Band 2	Band 3	Band 4	Resistance \pm tol		
Orange (3)	Orange (3)	Red (100Ω)	Gold (+5%)	$3.3\text{ k}\Omega \pm 5\%$	$3.243\text{ k}\Omega$	1.73%
Green (5)	Blue (6)	Red (100Ω)	Gold (+5%)	$5.6\text{ k}\Omega \pm 5\%$	$5.553\text{ k}\Omega$	0.84%

Table 2:

3.3 KΩ Voltage	Experimental readings		
	Current, I	Voltage, IR	Power, I^2R
2	0.62mA	2.01V	1.25mW
4	1.24mA	4.02V	4.99mW
6	1.86mA	6.03V	11.22mW
8	2.48mA	8.04V	19.95mW
10	3.09mA	10.02V	30.96mW

Questions and Answers:

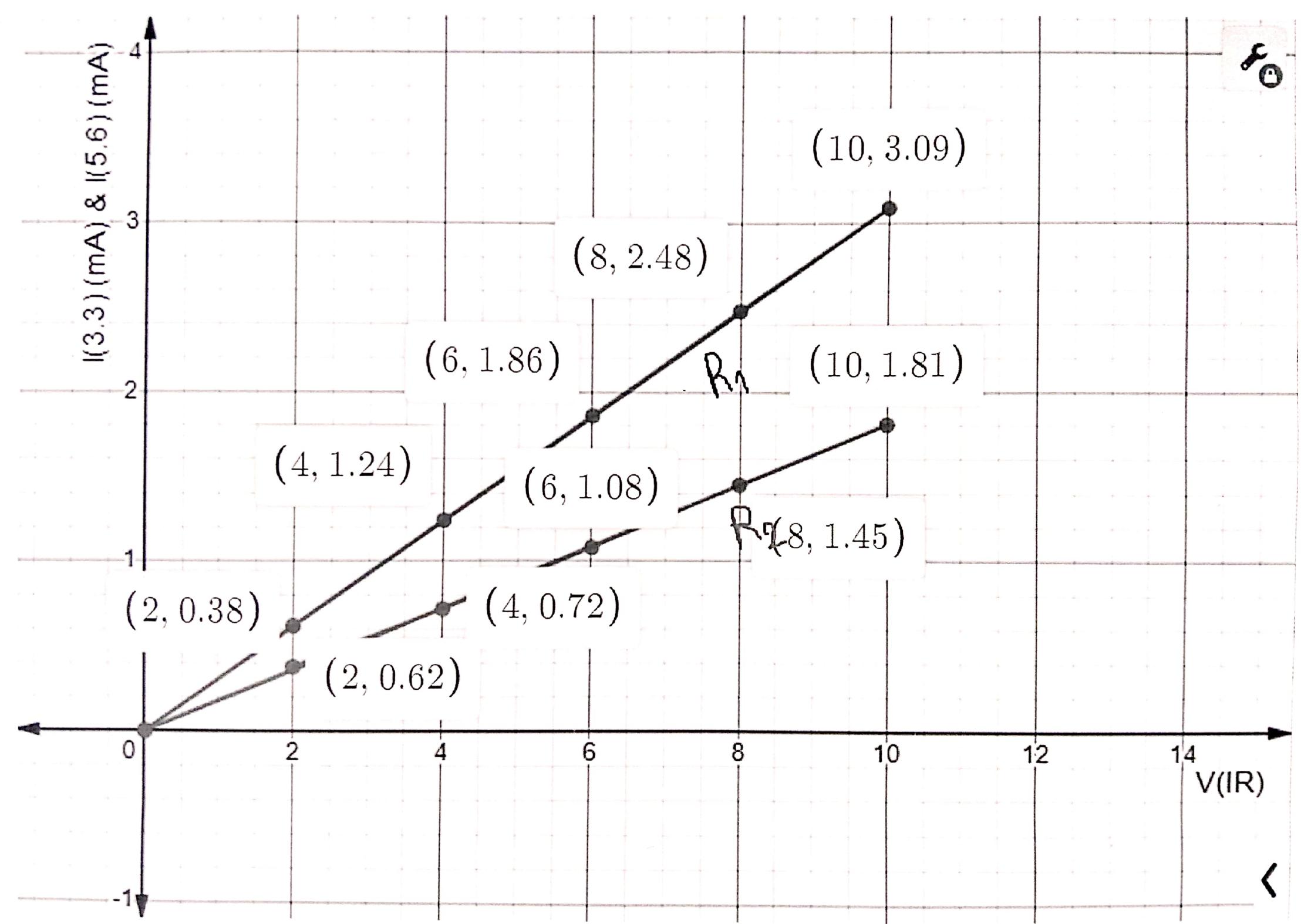
(1) State Ohm's law.

Answer: Ohm's law: Current through a conductor between two points is directly proportional to the voltage across the two points. Mathematically, Ohm's law can be expressed as, $I \propto V$, which with the constant of proportionality, the resistance R in the above equation, $I = \frac{V}{R}$ or, $V = IR$.

(2) Plot V vs I graph for each resistor value in same graph.

Answer: We had already measured the current flowing through the resistor by the Digital Multimeter in Laboratory and filled Table-2&3 with those values. Now we get the values from Table-2 and Table-3 and plotting the values on the graph.

Voltage, V	$I_{3.3}$ (mA)	$I_{5.6}$ (mA)
2	0.62	0.38
4	1.24	0.72
6	1.86	1.08
8	2.48	1.45
10	3.09	1.81



(3) Does your experimental circuit follow Ohms law? Explain how did you figure it out.

Answer: Given, Voltage, $V = (2V, 4V, 6V, 8V, 10V)$

Resistance, $R = (3.3K\Omega, 5.6K\Omega)$

We Know, $V = IR$ or, $I = \frac{V}{R}$

Voltage (V)	$I_{3.3} = \frac{V}{R_1}$ (mA)	$I_{5.6} = \frac{V}{R_2}$ (mA)
2	0.61	0.36
4	1.21	0.71
6	1.81	1.07
8	2.42	1.42
10	3.03	1.78

Yes, our experimental circuit follow Ohms law.

Ohm's law states that the electrical current flowing through any conductor is directly proportional to the potential difference voltage between its ends, assuming the physical conditions of the conductors do not change. So, $V = IR$ or, $I = \frac{V}{R}$

Therefore, if we use the Ohms law with the given resistor and voltage values, we can get our

theoretical data. Here we can see the theoretical data and our experimental data (from (2)) are almost same. For that reason, we can figure out that our experimental circuit follow Ohm's law.

(4) Calculate the resistance of each circuit using the slope of your V vs I graph. Compare these R values from the graph to the measured R values using DMM. Find the percent difference.

Answer: we get, Resistance, $R = \frac{V}{I}$

Experimental Data (Using DMM)				Theoretical Data (Using Ohm's law)					
$V(V)$	$I(mA)$	$I'(mA)$	$R(K\Omega)$	$R'(K\Omega)$	$V(V)$	$I(mA)$	$I'(mA)$	$R(K\Omega)$	$R'(K\Omega)$
2.01	0.62	0.38	3.2	5.5	2	0.61	0.36	3.3	5.6
4.02	1.24	0.72	3.2	5.5	4	1.21	0.71	3.3	5.6
6.03	1.86	1.08	3.2	5.5	6	1.81	1.07	3.3	5.6
8.04	2.48	1.45	3.2	5.5	8	2.42	1.42	3.3	5.6
10.02	3.09	1.81	3.2	5.5	10	3.03	1.78	3.3	5.6
			ΣR	$\Sigma R'$				ΣR	$\Sigma R'$
			= 16	= 27.5				= 16.5	= 28

Experimental Data (Using DMM) mean:

$$M_R = \frac{\sum R}{N} = \frac{16}{5} = 3.2$$

$$M_{R'} = \frac{\sum R'}{N} = \frac{27.5}{5} = 5.5$$

Theoretical Data (Using Ohm's law) mean:

$$M'_R = \frac{\sum R}{N} = \frac{16.5}{5} = 3.3$$

$$M'_{R'} = \frac{\sum R'}{N} = \frac{28}{5} = 5.6$$

The percent difference for the first resistance

$$= \frac{|M_R - M'_R|}{M'_R} \times 100\%.$$

$$= \frac{|3.2 - 3.3|}{3.3} \times 100\% = 3.03\%$$

The percent difference for the second resistance

$$= \frac{|M_{R'} - M'_{R'}|}{M'_{R'}} \times 100\% = \frac{|5.5 - 5.6|}{5.6} \times 100\% = 1.79\%$$

Result analysis & Discussion:

From Table-1,

For the first resistor = orange color orange color
(x Red color) ± Gold color

$$= 33 \times 100 \Omega \pm 5\%$$

$$= 3300 \Omega \pm 5\%$$

$$= 3.3 K \Omega \pm 5\%$$

For the second resistor = green color blue color
(x Red color) ± Gold color

$$= 56 \times 100 \Omega \pm 5\%$$

$$= 5600 \Omega \pm 5\%$$

$$= 5.6 K \Omega \pm 5\%$$

For the first resistor, the percentage error

$$= \frac{|3.243 - 3.3|}{3.3} \times 100\%$$

$$= 1.73\%$$

For the second resistor, the percentage error

20

$$= \frac{|5.553 - 5.6|}{5.6} \times 100\% = 0.84\%$$

From Table-2,

when, Voltage $V = 2V$, Current $I = 0.62mA$,

Resistance $R = 3.3K\Omega$

$$\text{Power, } I^2R = [(0.62)^2 \times 3.3] mW = 1.25 mW$$

when, Voltage $V = 4V$, Current $I = 1.24mA$,

Resistance $R = 3.3K\Omega$

$$\text{Power, } I^2R = [(1.24)^2 \times 3.3] mW = 4.99 mW$$

when Voltage $V = 6V$, Current $I = 1.86mA$,

Resistance $R = 3.3K\Omega$

$$\text{Power, } I^2R = [(1.86)^2 \times 3.3] mW = 11.22 mW$$

when Voltage $V = 8V$, Current $I = 2.48mA$,

Resistance $R = 3.3K\Omega$

$$\text{Power, } I^2R = [(2.48)^2 \times 3.3] mW = 19.95 mW$$

when Voltage $V = 10V$, Current $I = 3.09mA$,

Resistance $R = 3.3K\Omega$

$$\text{Power, } I^2R = [(3.09)^2 \times 3.3] mW = 30.96 mW$$

From Table-3,

when Voltage $V = 2V$, Current $I = 0.38mA$,

Resistance $R = 5.6K\Omega$

$$\text{Power, } I^2R = [(0.38)^2 \times 5.6] \text{ mW} = 0.802 \text{ mW}$$

when Voltage $V = 4V$, Current $I = 0.72mA$,

Resistance $R = 5.6K\Omega$

$$\text{Power, } I^2R = [(0.72)^2 \times 5.6] \text{ mW} = 2.879 \text{ mW}$$

when Voltage $V = 6V$, Current $I = 1.08mA$,

Resistance $R = 5.6K\Omega$

$$\text{Power, } I^2R = [(1.08)^2 \times 5.6] \text{ mW} = 6.477 \text{ mW}$$

when Voltage $V = 8V$, Current $I = 1.45mA$,

Resistance $R = 5.6K\Omega$

$$\text{Power, } I^2R = [(1.45)^2 \times 5.6] \text{ mW} = 11.675 \text{ mW}$$

when Voltage $V = 10V$, Current $I = 1.81mA$,

Resistance $R = 5.6K\Omega$

$$\text{Power, } I^2R = [(1.81)^2 \times 5.6] \text{ mW} = 18.192 \text{ mW}$$

From experiment 01, we learned about Ohm's Law and its verification by using the series circuit.

In the experiment, we were provided two resistors and could determine the value of the resistors by color coding. The first resistor was $3.3\text{K}\Omega$ and the second resistor was $5.6\text{K}\Omega$. We were also provided with a Digital Multimeter (DMM) to measure the current and voltage of the resistors. First, we took both $3.3\text{K}\Omega$ and $5.6\text{K}\Omega$ resistors and inserted them on the bread board. Then we measured the resistor's resistance values using DMM and wrote the values in Table-01. We calculated the percentage error between the theoretical and experimental values of the resistors. Then we only took the $3.3\text{K}\Omega$ resistor, made a series circuit using DC power supply as a

voltage source and set that on 2V. Now we measured the voltage using DMM and opened the circuit before taking the source voltage reading to avoid the loading effect of internal resistance. Then we measured the current flowing through the resistor and calculated IR and I^2R using the experimental values of I and R in Table-02. Then we did the same process for 4V, 6V, 8V and 10V voltage sources and calculated IR and I^2R using the experimental values of I and R in Table-02. We also did the same process for the 5.6K Ω resistor, measured the voltage and current flowing through the 5.6K Ω resistor using DMM and filled Table-03.

The experimental and the theoretical data and graphs are almost the same. It does have

flaws present in the real world, which could be coming from tolerance equipment in accuracy and loss of connection.

During the experimental, provided breadboard was not good and we faced some problems measuring current and voltage using DMM. Even then, we experimented properly.

Table of Contribution:

Mostroor Mofiz Arman	1921079642
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Muhammad Raiyan Alam	1831100642
Sumit Kumar Kar	2021646642

All the group members contributed equally.

Experiment Name:

Series Circuit

Objective:

- (1) we have to learn how to connect a series circuit on a breadboard.
- (2) we have to validate the voltage divider rules.
- (3) we have to verify Kirchhoff's voltage law.

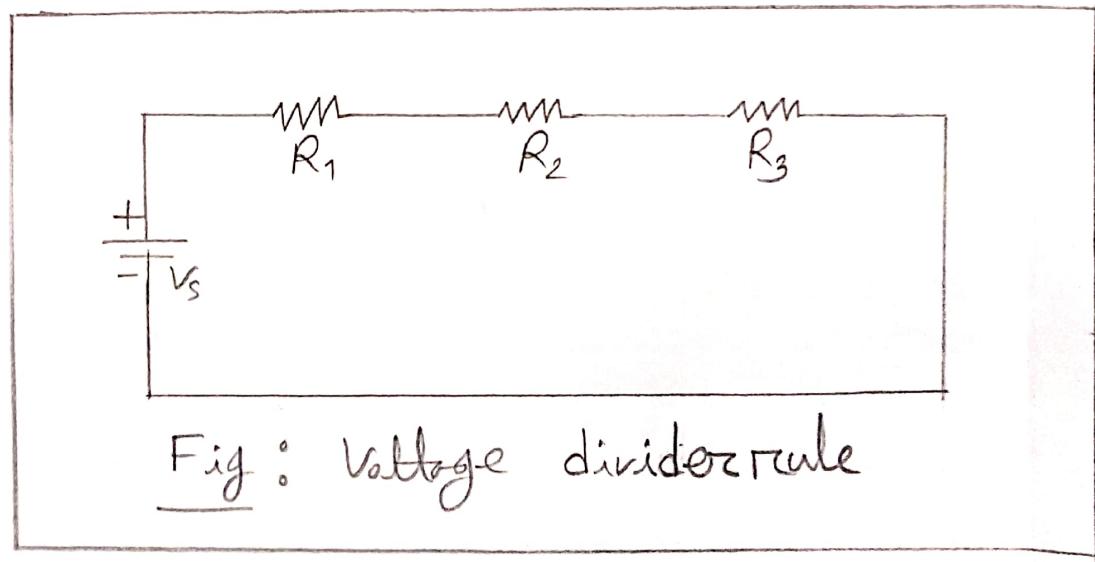
List of Equipment:

- (1) Bread board
- (2) DC power source
- (3) Resistors ($3.3\text{ k}\Omega$, $4.7\text{ k}\Omega$, $5.6\text{ k}\Omega$)
- (4) Digital Multimeter (DMM)
- (5) Connecting wire

Theory:

Voltage divider rule is the rule that a series circuit has more than one resistor, the voltage across of each resistor is the ratio of resistor value multiplied with voltage source to total resistance value. In other words, it is a fundamental rule of circuit in the field of electronics which can produce a portion of its input voltage as an output.

It is formed using two resistors and a voltage source. The resistors are connected in series here and the voltage is given across these two resistors.



2.4
Let consider the above circuit there are three resistances. Using voltage divider rule,

$$V_1 = \frac{R_1}{R_1 + R_2 + R_3} V_s$$

$$V_2 = \frac{R_2}{R_1 + R_2 + R_3} V_s$$

$$V_3 = \frac{R_3}{R_1 + R_2 + R_3} V_s$$

Or,
 $V_n = E \cdot \frac{R_x}{R_T}$

where,

V_n = voltage across one or more elements

E = Total supply voltage

R_x = The resistance between the output point

R_T = The total resistance of all elements of the divisor.

Kirchhoff's Voltage Law (KVL) states that the algebraic sum of all voltages in a loop must equal zero. Mathematically, it can be expressed

as, $\sum_{m=1}^M V_m = 0$, where M is the number of voltages in the loop and V_m is the m number of voltage.

Or,

$$\sum E + \sum V = 0$$

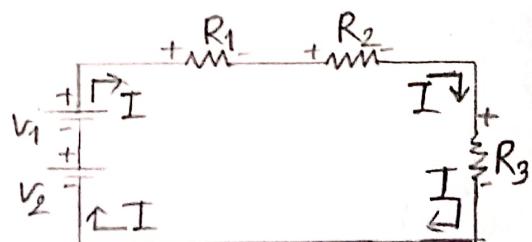


Fig: Kirchhoff's Voltage Law

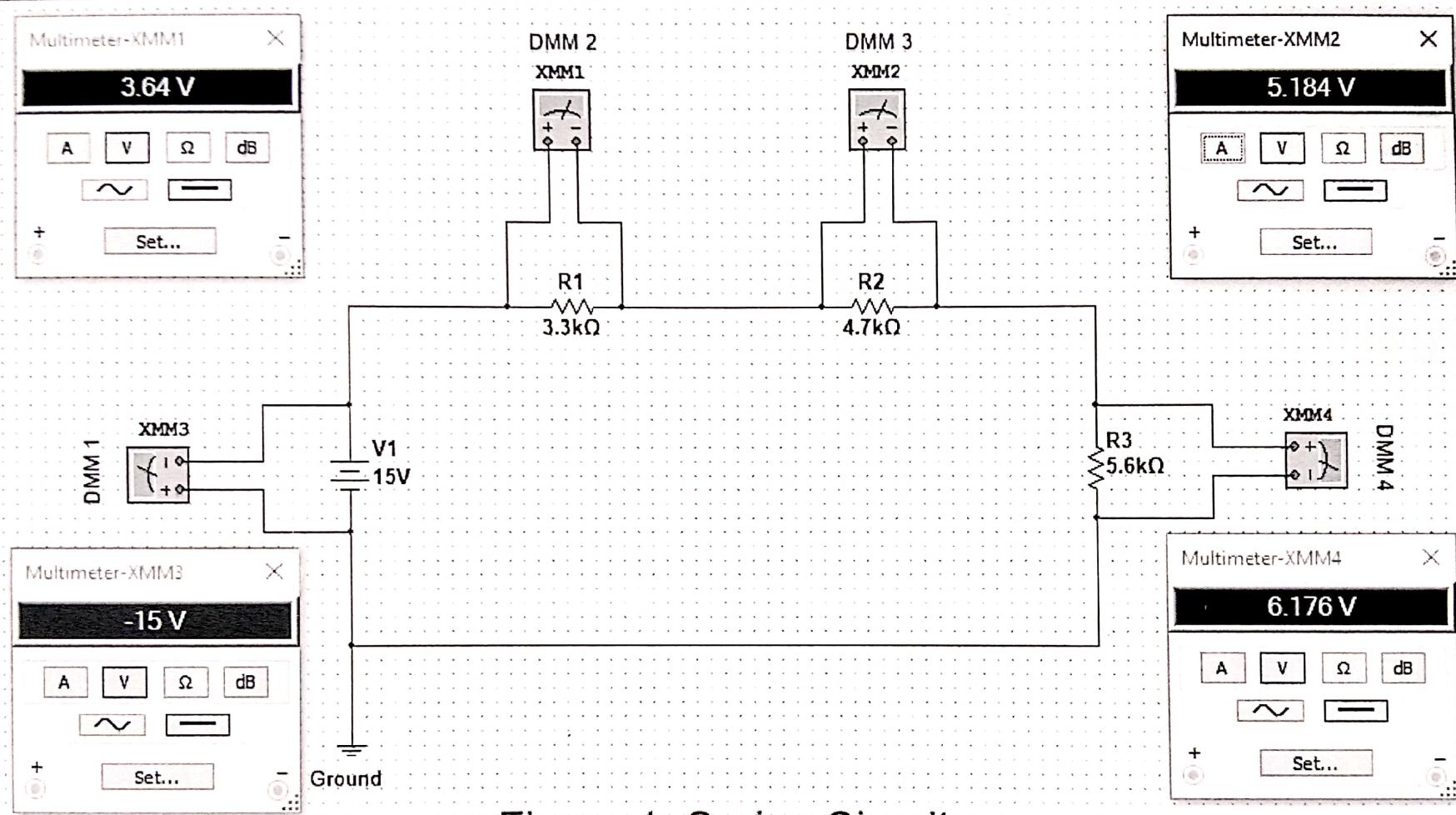


Figure 1: Series Circuit

Mosroor Mofiz Arman 1921079642

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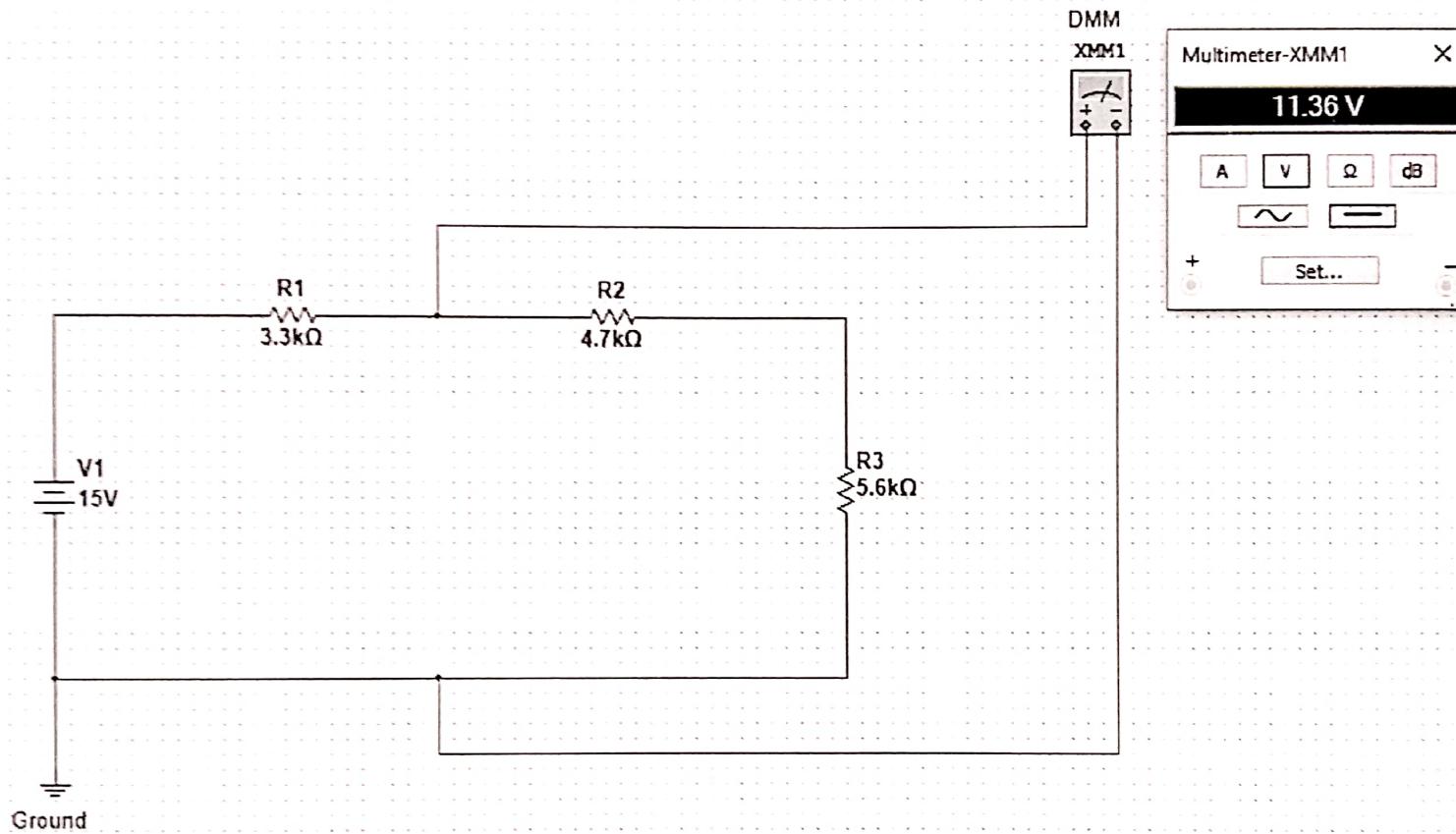


Figure 2: Series Circuit

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Department of Electrical & Computer Engineering



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Data Collection for Exp2:

Lab 1: Exp2

Group No. 4

Instructor's Signature M. Fazlul

Please do all the calculations in 3 significant figures or 2 decimal places where applicable

Table 1:

Resistance using colour coding					Resistance ± tol	Resistance using DMM	% Error
Band 1	Band 2	Band 3	Band 4				
Orange (3)	Orange (3)	Red (1000)	Gold (±5%)	3.3K±1.5%	3.195KΩ	3.182KΩ	3.182%
Yellow (4)	Violet (7)	Red (1000)	Gold (±5%)	4.3KΩ±5%	4.65KΩ	4.65KΩ	1.064%
Green (5)	Blue (6)	Red (1000)	Gold (±5%)	5.6KΩ±5%	5.64KΩ	5.64KΩ	1.071%

Table 2:

Experimental readings				Theoretical values			
V _s	V _{R1}	V _{R2}	V _{R3}	V _s	V _{R1}	V _{R2}	V _{R3}
15.05V	3.591V	5.21V	6.21V	15V	3.64V	5.18V	6.18V
% Error							
V _s	V _{R1}		V _{R2}		V _{R3}		
0.33%	1.35%		0.58%		0.49%		

Table 3:

Potential rise V _s	15.05V	Are the voltage rises and drops equal?
Potential drops (V _{R1} + V _{R2} + V _{R3})	(3.591V + 5.21V + 6.21V) = 15.01V	Yes

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Table 4:

Experimental readings		Theoretical values	
V _{ab}	R _{eq}	V _{ab}	R _{eq}
11.46V	13.41KΩ	11.36V	13.6KΩ
% Error			
V _{ab}		R _{eq}	
0.88%		1.39%	

Report

Experiment 1:

1. State Ohm's law.
2. Plot V vs I graph for each resistor value in same graph.
3. Does your experimental circuit follow ohm's law? Explain how did you figure it out.
4. Calculate the resistance of each circuit using the slope of your V vs I graphs. Compare these Rgraph values to the measured R values using DMM. Find the percent difference.

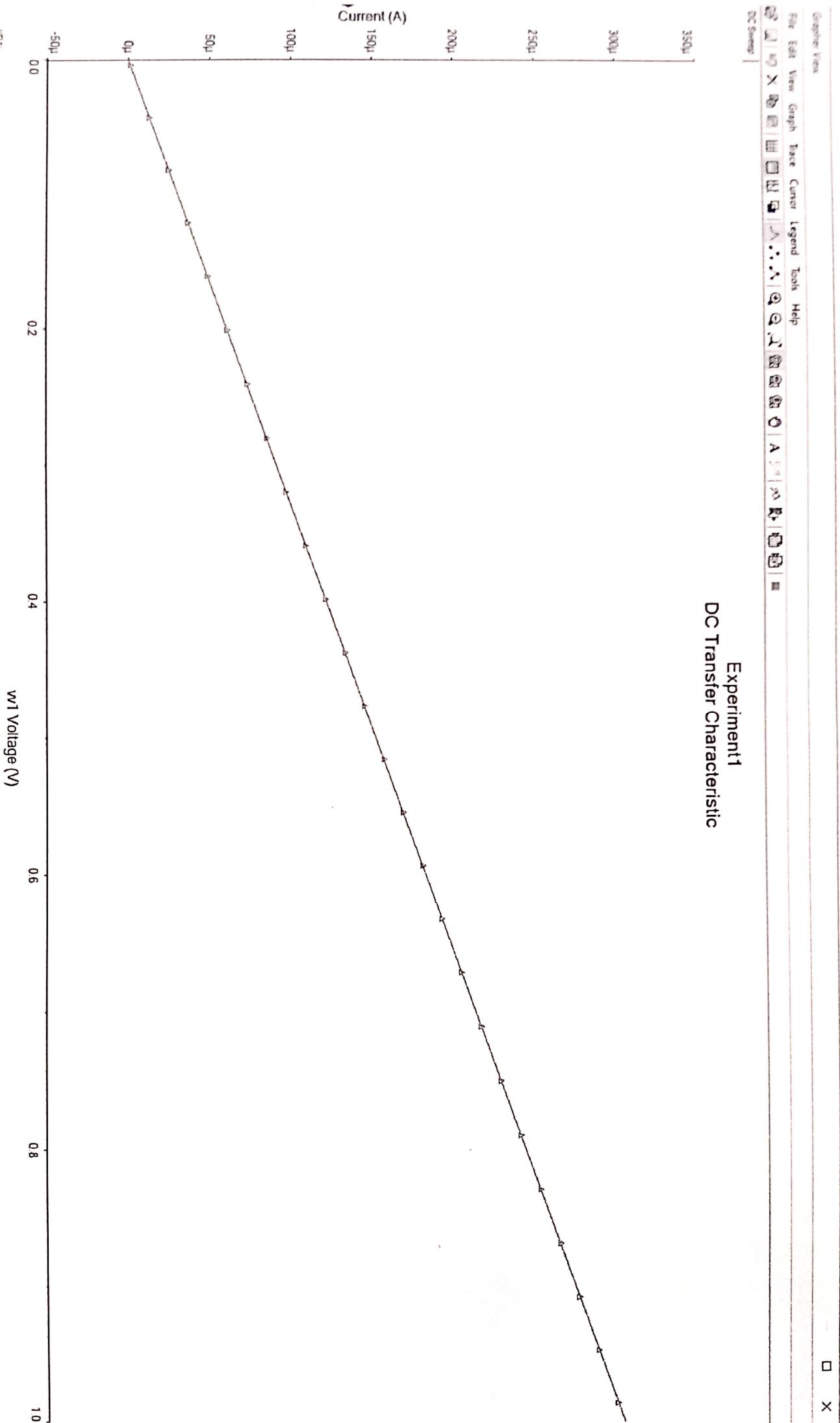
Experiment 2:

1. State the voltage division rule.
2. State the Kirchhoff's voltage law (KVL).
3. Showing all steps, calculate the theoretical values in Table 2. Compare theoretical values to your experimental values and explain whether your circuit follows KVL or not.
4. Showing all the calculations, theoretically calculate V_{ab}. Compare with the experimental value and verify the voltage division rule at the terminal a-b.
5. Showing all the steps, calculate R_{eq}. Compare with the experimental value.

Useful Formula:

Voltage Divider Rule: $V_X = E \frac{R_X}{R_T}$

% Error = $(\text{Theoretical value} - \text{Experimental Value}) / \text{Theoretical Value}$



Questions and Answers:

(1) State the voltage division rule.

Answer: The voltage division rule states that the total voltage applied across a series connection of multiple resistors is divided among the resistors in proportion to their resistance. The voltage division rule can be expressed

$$\text{as } V_n = E \frac{R_x}{R_T}$$

(2) State the Kirchhoff's voltage law (KVL).

Answer: The Kirchhoff's voltage law (KVL) states the voltage around a closed path algebraically sum to zero. In other words, the sum of voltage rise equals the sum of voltage drop.

$$\text{The equation is: } \sum_{m=1}^M V_m = 0$$

(3) Showing all steps, calculate the theoretical values in Table 2. Compare theoretical values to your experimental values and explain whether your

2.A

Circuit follows KVL or not.

Answer: Experimental Data:

$$\text{Total Resistance, } R_T = R_1 + R_2 + R_3 = (3.195 + 4.65 + 5.5) \text{ k}\Omega \\ = 13.385 \text{ k}\Omega$$

Power Source, $V_s = 15.05V$

$$V_{R_1} = \frac{15.05 \times 3.195}{13.385} V = 3.591V$$

$$V_{R_2} = \frac{15.05 \times 4.65}{13.385} V = 5.21V$$

$$V_{R_3} = \frac{15.05 \times 5.54}{13.385} V = 6.21V$$

Theoretical Data:

$$\text{Total Resistance, } R'_T = R'_1 + R'_2 + R'_3 = (3.3 + 4.7 + 5.6) \text{ k}\Omega \\ = 13.6 \text{ k}\Omega$$

Power Source, $V'_s = 15V$

$$V'_{R_1} = \frac{15 \times 3.3}{13.6} V = 3.64V$$

$$V'_{R_2} = \frac{15 \times 4.7}{13.6} V = 5.18V$$

$$V'_{R_3} = \frac{15 \times 5.6}{13.6} V = 6.18V$$

2.8
Comparison:

$$V_1 = \frac{|V_{R_1} - V'_{R_1}|}{V_{R_1}} \times 100\% = \frac{|3.591 - 3.641|}{3.64} \times 100\%$$
$$= 1.35\%$$

$$V_2 = \frac{|V_{R_2} - V'_{R_2}|}{V_{R_2}} \times 100\% = \frac{|5.21 - 5.18|}{5.18} \times 100\%$$
$$= 0.58\%$$

$$V_3 = \frac{|V_{R_3} - V'_{R_3}|}{V_{R_3}} \times 100\% = \frac{|6.21 - 6.18|}{6.18} \times 100\%$$
$$= 0.49\%$$

For Experimental Data,

$$\text{Voltage Rise} = 15.05V \approx 15V$$

$$\text{Voltage Drop} = (V_{R_1} + V_{R_2} + V_{R_3}) = (3.591 + 5.21 + 6.21) V$$
$$= 15.01V \approx 15V$$

For Theoretical Data,

$$\text{Voltage Rise} = 15V$$

$$\text{Voltage Drop} = (V'_{R_1} + V'_{R_2} + V'_{R_3}) = (3.6 + 5.18 + 6.18)V$$
$$= 15V$$

2.7
Therefore, voltage rise = voltage drop which follows KVL.

(4) Showing all calculations, theoretically calculate V_{ab} . Compare with the experimental value and verify the voltage division rule at the terminal a-b.

Answer: Experimental Data:

$$V_{ab} = 11.46 \text{ V}$$

Theoretical Data:

$$V'_{ab} = V_s - V_a = (15 - 3.64)V = 11.36V$$

$$\therefore \text{Comparison} = \frac{|V_{ab} - V'_{ab}|}{V'_{ab}} \times 100\%.$$

$$= \frac{|11.46 - 11.36|}{11.36} \times 100\%$$

$$= 0.88\%.$$

As the result is almost same, we can say that the voltage division rule at the terminal a-b is verified.

7.20
(5) Showing all steps, calculate R_{eq} . Compare with the experimental value.

Answer: Experimental Data:

$$R_{eq} = 13.41 \text{ k}\Omega$$

Theoretical Data:

$$\begin{aligned} R'_{eq} &= R'_1 + R'_2 + R'_3 = (3.3 + 4.7 + 5.6) \text{ k}\Omega \\ &= 13.6 \text{ k}\Omega \end{aligned}$$

$$\therefore \text{Comparison} = \frac{|R_{eq} - R'_{eq}|}{R'_{eq}} \times 100\%.$$

$$= \frac{|13.41 - 13.6|}{13.6} \times 100\%$$

$$= 1.39\%.$$

Result analysis & Discussion:

From Table - 1,

For the first resistor = orange color orange color (x red color) ± gold color

$$= 33 \times 100 \Omega \pm 5\%$$

$$= 3300 \Omega \pm 5\%$$

$$= 3.3K \Omega \pm 5\%$$

For the second resistor = yellow color violet color (x red color) ± gold color

$$= 47 \times 100 \Omega \pm 5\%$$

$$= 4700 \Omega \pm 5\%$$

$$= 4.7K \Omega \pm 5\%$$

For the third resistor = green color blue color (x red color) ± gold color

$$= 56 \times 100 \Omega \pm 5\%$$

$$= 5600 \Omega \pm 5\%$$

$$= 5.6K \Omega \pm 5\%$$

7.2

For the first resistor, the percentage error

$$= \frac{|13.195 - 3.31|}{3.3} \times 100\% = 3.182\%.$$

For the second resistor, the percentage error

$$= \frac{|14.65 - 4.71|}{4.7} \times 100\% = 1.064\%.$$

For the third resistor, the percentage error

$$= \frac{|15.54 - 5.6|}{5.6} \times 100\% = 1.071\%.$$

From Table-2,

Power Source, $V_s = 15V$

$$\begin{aligned} \text{Total Resistance, } R_T &= (3.3 + 4.7 + 5.6) k\Omega \\ &= 13.6 k\Omega \end{aligned}$$

$$\therefore V_{R_1} = \frac{15 \times 3.3}{13.6} V = 3.64V$$

$$\therefore V_{R_2} = \frac{15 \times 4.7}{13.6} V = 5.18V$$

$$\therefore V_{R_3} = \frac{15 \times 5.6}{13.6} V = 6.18V$$

7.2

Error :

$$V_s = \frac{|15.05 - 15|}{15} \times 100\% = 0.33\%$$

$$V_{R_1} = \frac{|3.591 - 3.64|}{3.64} \times 100\% = 1.35\%$$

$$V_{R_2} = \frac{|5.21 - 5.18|}{5.18} \times 100\% = 0.58\%$$

$$V_{R_3} = \frac{|6.21 - 6.18|}{6.18} \times 100\% = 0.49\%$$

Potential rise, $V_s = 15.05V$

$$\begin{aligned}\text{Potential drops} &= (V_{R_1} + V_{R_2} + V_{R_3}) \\ &= (3.591 + 5.21 + 6.21)V \\ &= 15.01V\end{aligned}$$

From Table-4,

$$V_{ab} = (15 - 3.64)V = 11.36V$$

$$R_{eq} = (3.3 + 4.7 + 5.6)K\Omega = 13.6K\Omega$$

Error :

$$V_{ab} = \frac{|11.46 - 11.36|}{11.36} \times 100\% = 0.88\%$$

$$R_{eq} = \frac{|13.41 - 13.6|}{13.6} \times 100\% = 1.39\%$$

From experiment 02, we learned about Kirchhoff's Law and the voltage divider rule by using the series circuit.

In the experiment, we were provided three resistors and could determine the value of the resistors by color coding. The first resistor was $3.3\text{ k}\Omega$, the second resistor was $4.7\text{ k}\Omega$ and the third resistor was $5.6\text{ k}\Omega$. We were also provided with a Digital Multimeter (DMM) to measure the current and voltage of the resistors. First, we took all resistors and inserted them on the breadboard. Then we measured the resistors resistance values using DMM and wrote the values in Table-01. We calculated the percentage errors between the theoretical and experimental values of the resistors. Then we made a series circuit with those

resistors using the DC power supply as a voltage source and set that on 15V. We measured the potential difference across the voltage source and resistors using DMM and wrote the values in Table-02. Then we filled Table-03 by calculating the values from Table-02. Afterward, we find out both experimental and theoretical values of V_{ab} and total load resistance (R_{eq}) values using DMM and filled Table-04. Before measuring R_{eq} , we ensured that the voltage source DC power supply was disconnected.

The experimental and theoretical data and graphs are almost same. It does have flaws present in the real world, which could be coming from tolerance equipment in

accuracy and loss of connection.

During the experiment, provided breadboard was not good and we faced some problems measuring current and voltage using DMM. Even then, we experimented properly.

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