**PHYSICS 1E03 LAB 2 WRITE-UP**

**OHM’S LAW & KIRCHHOFF’S LAWS**

**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Lab Section:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Student No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Partner:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Lab Section:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Student No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Station Number:\_\_\_\_\_\_\_\_\_\_\_\_\_**

**RESULTS**

**PART 1: Measuring Electric Quantities with Ammeters & Voltmeters**

**Measured voltage for R1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Measured current for R1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Calculated current for R1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**PART 2: Circuit Analysis**

**Calculated equivalent resistance for Circuit\_2:** $R\_{eq}=$**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Circuit\_2 Graph**

Place your graph for Circuit\_2 from the procedure for Part 2 here:

**Part 3: Voltage Dividers**

**Circuit\_3 Analysis**

**Table 1**

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| **Measured Nodes** | **Experimental Voltage (V)** | **Analytic Voltage (V)** |
| Node 1 to Node 2 |  |  |
| Node 2 to Node 3 |  |  |

**PART 4: Kirchhoff’s Rules – Circuit with Two Loops**

**Sum of potentials around the loops (clockwise):**

Ʃ potentials around loop 1: $V\_{1}-I\_{1}R\_{2}-I\_{3}R\_{3}-I\_{1}R\_{1}-V\_{2}=0$

Ʃ potentials around loop 2:$V\_{2}-I\_{2}R\_{4}+I\_{3}R\_{3}=0$

Kirchhoff’s Junction: $I\_{1}=I\_{2}+I\_{3}$

Table 2: Measured Resistance from the Multimeter (use uncertainty of multimeter)

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| Resistor Label | Measured Value ($Ω)$ |
| R1 | $$\pm $$ |
| R2 | $$\pm $$ |
| R3 | $$\pm $$ |
| R4 | $$\pm $$ |

Table 3: Voltage Measured across each Circuit Element (use uncertainty of multimeter)

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| --- | --- |
| Circuit Element | Measured Voltage (V) |
| R1 | $$\pm $$ |
| R2 | $$\pm $$ |
| R3 | $$\pm $$ |
| R4 | $$\pm $$ |
| V1 | $$\pm $$ |
| V2 | $$\pm $$ |
| Sum of Voltages for Loop 1 |  |
| Sum of Voltages for Loop 2 |  |

Table 4: Current Measured at Junctions 1 & 2 (use uncertainty of multimeter)

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| --- | --- | --- | --- |
| Current label | Experimental Current at Junction 1 ($A)$ | Experimental Current at Junction 2 ($A)$ | Theoretical Current at Junction 1 ($A)$(from pre-lab) |
|  I1 | $$\pm $$ | $$\pm $$ |  |
|  I2 | $$\pm $$ | $$\pm $$ |  |
|  I3 | $$\pm $$ | $$\pm $$ |  |
|  Sum of Iin |  |  |  |
|  Sum of Iout |  |  |  |

**DISCUSSION AND CONCLUSIONS**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Question 1.*** Does the measured value for current match the calculated value for current from Ohm’s law for Circuit\_1? Explain why or why not. Hint: How close is your measured voltage value to the set voltage of the power supply? To answer this question quantitatively, calculate the percentage difference between the expected and experimental values using the following formula for the percent difference test:

If$ \frac{\left|A-B\right|}{(A+B)/2}\*100\%\leq 10\%$, then $A=B$ within 10% uncertainty, where A and B are theoretical and experimental values, respectively.

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***Question 2.*** If you were to replace the resistor R1 with a resistance of 100 M$Ω$, do you think you would obtain an accurate measurement of voltage from the voltmeter? Explain why or why not.

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***Question 3.*** What would it mean if your measured values for current or voltage were negative? Explain.

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***Question 4.*** What is the significance of the y-intercept from the graph obtained from Circuit\_2? Does the voltmeter affect the circuit at all? Explain.

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***Question 5.*** Instead of using the line of best fit to determine the equivalent resistance, you could have calculated it by taking only one current measurement for one voltage value. Why do you think we used the line of best fit for this instead of taking a multitude of measurements?

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***Question 6.*** Does your analytic results for the voltage between NODE2 and NODE3 match what you found experimentally to within 10%? Explain why or why not.

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***Question 7.*** Imagine a separate device, which requires a lower voltage than what the power supply provides, is attached to Circuit\_3 between NODE2 and NODE3. What should we do in order to manipulate the voltage at NODE2? Note: voltage dividers are found all the time within circuits and are often needed to manage or redistribute extremely high voltage sources.

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***Question 8.*** Do your experimental values of voltage and current from Circuit\_4 agree with Kirchhoff’s Laws? Justify your answer.

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***Question 9.*** Do your experimental values for the currents I1, I2, and I3 match the theoretical values you obtained in the pre-lab section? Show your calculations for currents here and compare to experimental values using the percent difference test.

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***Question 10***. What are the different sources of error associated with measuring the electric quantities for Circuit\_4? Hint: recall how the voltmeter and ammeter affected the measurements in the earlier part of this lab. Also consider any extra uncertainties introduced in this lab.

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