Basic Electronics Lab 04
Fundamentals of Circuit Measurement: Exploring Ohm's Law with Digital Multimeters

Name: _____ Reg. No. _____ Section: _____

Objective:

To understand the measurement techniques for current and voltage using a Digital Multimeter (DMM), verify Ohm's Law by constructing a variable voltage source, and simulate the circuits using CircuitMaker and Tinkercad.

Materials Required:

- Digital Multimeter (DMM)
- Breadboard
- Resistors (Various values)
- Potentiometer
- DC Power Supply
- Connecting Wires
- CircuitMaker software for virtual circuit design and simulation
- Tinkercad.com account for virtual circuit design and simulation

Theory:

Current and Voltage Measurement:

A Digital Multimeter (DMM) is an essential tool for measuring electrical quantities like current and voltage. Current Measurement: To measure the current, the DMM must be connected in series with the circuit element where current flows. In this configuration, the DMM acts as a part of the circuit, and the measured current is the same as that flowing through the component.

Voltage Measurement: Voltage measurement is done by connecting the DMM in parallel across the component whose voltage is being measured. This ensures that the DMM does not significantly affect the circuit operation, as it only measures the potential difference across the component.

Ohm's Law:

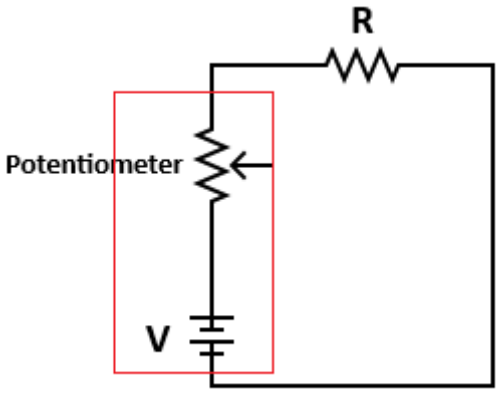
Ohm's Law is a fundamental principle in electronics which states that the voltage (V) across a resistor is directly proportional to the current (I) passing through it, with the proportionality constant being the resistance (R). The mathematical representation is:

$$V = IR$$

This implies that for a constant resistance, the current varies linearly with the applied voltage. The slope of the V-I graph gives the resistance value.

Building a Variable Voltage Source:

A DC power supply is a crucial element in circuit design, offering the flexibility to vary voltage levels precisely. Unlike a fixed voltage source (like a battery), a DC power supply allows continuous adjustment of voltage to study its effects on current.



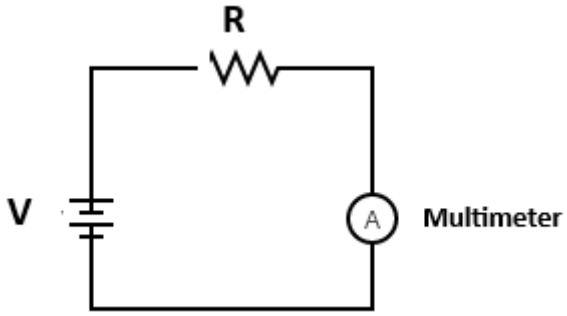
Lab Procedure:

Step 1: Current Measurement using DMM

Set the DMM to measure current.

Break the circuit at the point where you want to measure the current and insert the DMM in series.

Record the current readings for different resistors.



Task 1:

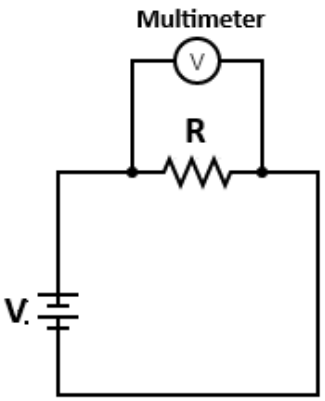
Build a simple circuit with a DC power supply and a resistor of known value. Measure the current passing through the resistor using the DMM. Compare the measured values with the theoretical current values using Ohm's Law.

Step 2: Voltage Measurement using DMM

Set the DMM to measure voltage.

Connect the DMM in parallel with the component whose voltage needs to be measured.

Record the voltage readings across different components in the circuit.



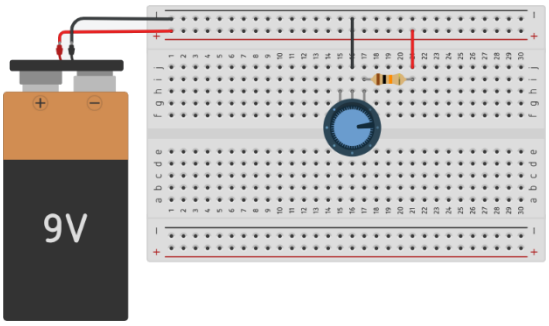
Task 2:

Build a circuit with a DC power supply and a series combination of two resistors. Measure the voltage across each resistor using the DMM. Compare the measured values with the theoretical voltage drop using Ohm's Law.

Step 3: Ohm's Law Verification

Connect a DC power supply in series with a fixed resistor.

Vary the voltage using the DC power supply and measure the voltage and current using the DMM.



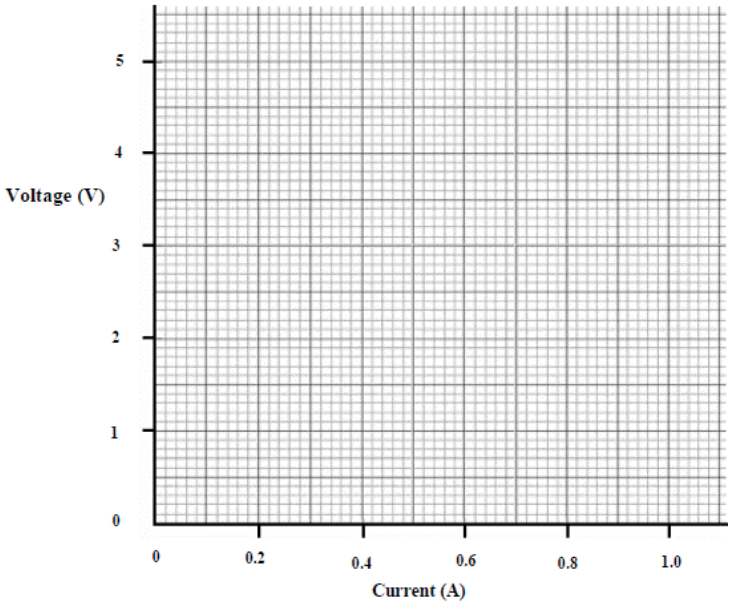
Task 3:

For a fixed resistor, vary the voltage using the DC power supply and record the current in the following table:

No.	Voltage (V)	Current (A)
1		
2		
3		
4		
5		

Task 4:

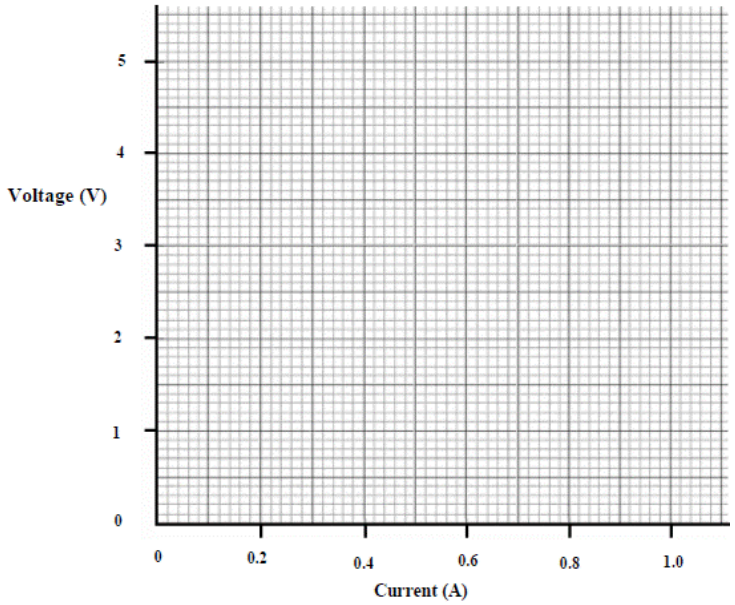
Plot a graph of Voltage (V) on the x-axis and Current (A) on the y-axis. Calculate the slope of the line, which represents the resistance R.



Task 5:

Replace the fixed resistor with another resistor of a different value. Again, vary the voltage using the DC power supply and record the new set of current readings. Plot these values in a new graph and find the slope.

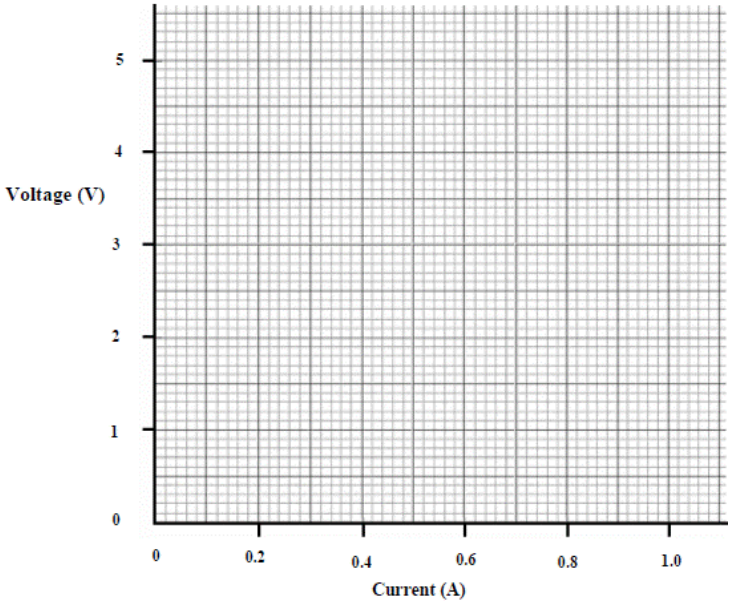
No.	Voltage (V)	Current (A)
1		
2		
3		
4		
5		



Task 6:

Change the resistor again to a third value. Follow the same steps of varying the voltage, recording the current, and plotting the graph to find the slope.

No.	Voltage (V)	Current (A)
1		
2		
3		
4		
5		



Step 4: Simulation on Tinkercad

Create an account and log in to Tinkercad.
Design the circuit using a DC power supply and resistors in the Tinkercad virtual environment.
Use the built-in virtual multimeter to measure voltage and current.

Task 7:

Build a simple circuit in Tinkercad with a variable DC power supply and a resistor. Simulate the voltage variations and observe the current readings using the virtual multimeter.

Task 8:

Replace the resistor with another value and repeat the simulation. Compare the simulated results with the actual measurements taken in previous tasks.

Task 9:

Use Tinkercad to design and simulate a circuit with three resistors in parallel. Measure the equivalent resistance virtually and compare it with values recorded using the DMM.

Task 10:

1. *Create a circuit in CircuitMaker with a variable resistor (potentiometer) connected to a DC power supply.*
2. *Set the DC power supply to a specific voltage and adjust the potentiometer to different resistance values.*
3. *Measure the current flowing through the circuit using the virtual DMM for at least five different resistance settings.*
4. *Record your measurements in the following table and calculate the theoretical current using Ohm's Law for each setting.*

No.	Resistance (Ω)	Voltage (V)	Measured Current (A)	Theoretical Current (A)
1				
2				
3				
4				
5				

Post-Lab Questions:

What is the significance of connecting the DMM in series for current measurement and in parallel for voltage measurement?
How can you use a DC power supply to create a variable voltage source?
Describe the impact of varying voltage on current for a fixed resistance as observed in this experiment.

Conclusion:

In this lab, you learned to measure current and voltage using a DMM, verified Ohm's Law by creating a variable voltage source using a DC power supply, and simulated circuits using CircuitMaker and Tinkercad. This provided hands-on experience with practical circuit analysis and reinforced key concepts in electronics.