MARINE INSTITUTE

Electrotechnology 1100

Experiment 2

Ohm's Law

SAMPLE CALCULATIONS:

Using your own data, provide one worked sample of each formula used in this Lab.

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

Table 2-1, Step 5

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

Question 2, Table 2-2

BASIC INFORMATION

Ohm's law states that the current (I) flowing in an electric circuit is proportional to the applied voltage (V_T) and inversely proportional to the resistance (R).

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

This means that if the voltage is increased, the current will increase if the resistance is constant. Similarly, if resistance is increased, the current will decrease if voltage is constant.

Ohm's law is the most important tool for the analysis of electric circuits. There are many other rules and laws, but you must know and be able to apply Ohm's Law.

OBJECTIVES:

When you have completed this experiment, you should be able to:

- Measure voltage in a circuit.
- Measure current in a circuit.
- Verify the effect of voltage in controlling current.
- Verify the effect of resistance in controlling current.
- Verify the relationship between voltage, current and resistance in an electric circuit.

EQUIPMENT & MATERIALS REQUIRED:

Power Supply:	0-60/70V dc.
Instruments:	Analog Ohmmeter.
	Analog Voltmeter.
	Analog Milliammeter.
Resistors:	560Ω.
	10kΩ or 5kΩ potentiometer.
Miscellaneous:	Orange board.
	3 Black Alligator Clip to Banana Plug test leads.
	3 Red Alligator Clip to Banana Plug test leads.
	Quick clips.

PROCEDURE:

1. Orient the 10kΩ (or 5kΩ) potentiometer as shown in Figure 2-1 and connect a jumper (quick clip) between terminals C and B. This converts the potentiometer to a rheostat with a range of resistance from 0-10kΩ.

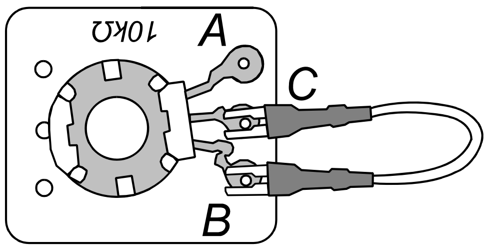


Figure 2-1

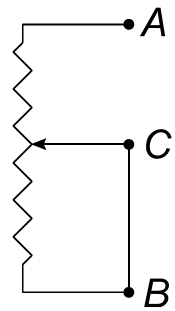


Figure 2-2

Figure 2-2 shows the schematic diagram of the rheostat.

2. Set the ohmmeter on the Rx1000 or Rx1K scale. Zero the ohmmeter.

3. Connect the ohmmeter between terminals A and B as shown in Figure 2-3. Figure 2-4 shows the schematic diagram of this circuit.

   Adjust the resistance to 1000Ω. The accuracy of your results will depend on the accuracy of setting the potentiometer.

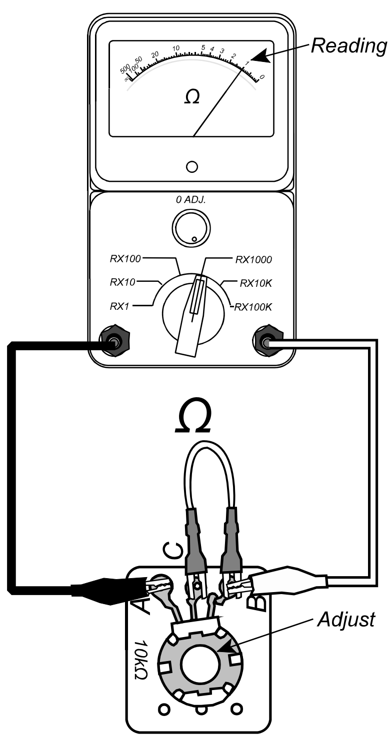


Figure 2-3

The ohmmeter is the only meter where we read off of the scale and apply a multiplier.

In this case, Rx1000 means you take the reading off of the scale and multiply by 1000 to get the reading.

1 x 1000 = 1000Ω

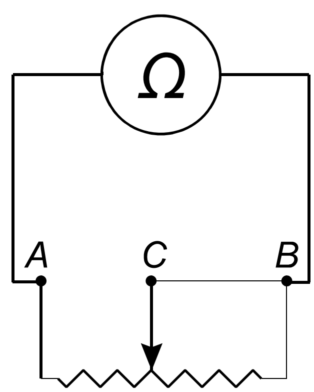


Figure 2-4

4. Connect the circuit shown in Figures 2-5 and 2-6. Set the voltmeter on the 10V range (sets Maximum, so scale goes from 0-10V) and the milliammeter on the 10mA range (scale 0-10mA). **Have a demonstrator check the circuit before applying power.**

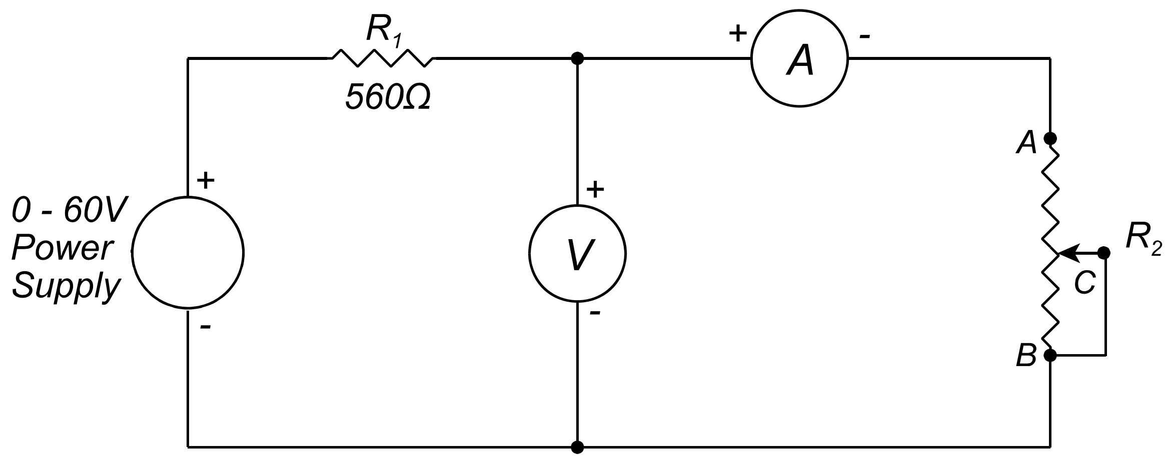


Figure 2-5

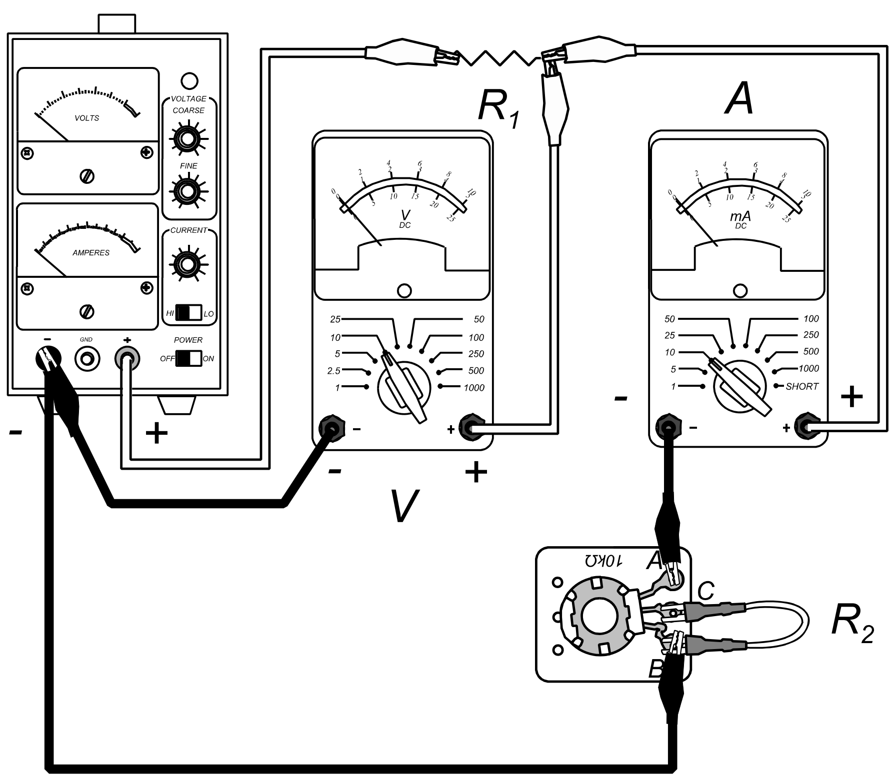


Figure 2-6

TIP

Do not read voltage and current off of the power supply (≈20% error).

Use Voltmeter and Ammeter.

5. Using the voltages in Table 2-1 and 1000Ω, calculate the theoretical currents using Ohm's law and record the currents in mA in Table 2-1.

$$I = \frac{V_T}{R}$$ Formula 1.

6. Turn on the power supply. Slowly increase the voltage until the voltmeter indicates 2 volts. Measure the current on the milliammeter and record in Table 2-1.

7. If your measured current in Step 6 is not within 10% (10% of 2mA = 0.2mA, so range = 1.8-2.2 mA), then the potentiometer resistance may not have been set correctly. Turn off the power supply. Remove the potentiometer from the circuit and repeat Step 3.

   Have a demonstrator check your results if you are unsure.

8. Adjust the power supply for the voltages shown in Table 2-1 and record the corresponding currents.

9. Turn off the power supply. Remove the potentiometer from the circuit. Using the ohmmeter, adjust the resistance to 2000Ω. Replace the potentiometer in the circuit.

10. Repeat steps 5, 6, 7, 8 and 9 for potentiometer resistances of 2000Ω and 4000Ω using Tables 2-2 and 2-3, respectively. Be sure to use the voltages from the Tables. You will have to increase the scale of the voltmeter at some point (12V cannot be read on a 10V scale).

11. **Have a demonstrator check your results before disconnecting the circuit.**

12. Disconnect your circuit and return all equipment to it's proper place.

RESULTS:

Table 2-1 - 1000Ω

	Current (mA)	
Voltage (V)	Calculated	Measured
2		
4		
6		
8		
10		

Table 2-2 - 2000Ω

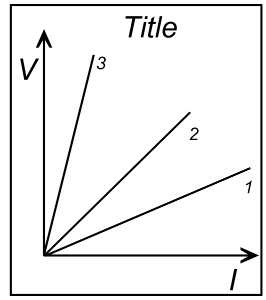
	Current (mA)	
Voltage (V)	Calculated	Measured
4		
6		
8		
10		
12		

Table 2-3 - 4000Ω

	Current (mA)	
Voltage (V)	Calculated	Measured
6		
8		
10		
12		
14		

QUESTIONS:

1. Plot graphs of Voltage vs Current for the **MEASURED** data in each table. Plot **ALL** the graphs on the same axes with voltage on the vertical axis and current on the horizontal axis.



Make your graph as large as possible. Do not connect the dots, but draw the line of best fit. If no more than 2 of your data points are aligned, then draw your line as an average. But if 5, 4 or 3 of your data points are aligned, draw your line through them (highlights experimental errors). It is not essential that your graph pass through the origin.

What are the similarities between these graphs? What does the slope of each graph represent?

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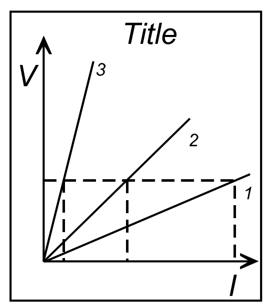
2. From the graphs, calculate the resistance for each potentiometer setting at a voltage level of 9 volts.



Draw a horizontal line at 9V. Each time this line crosses a graph line, drop a vertical line to the x-axis. Read off current and calculate resistance.

How do these values compare to the **THEORETICAL** resistance values you calculated?

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3. What can you conclude about the relationship between current and voltage, if resistance is constant? Refer to your measurements in Table 2-1 to support your answer.

4. What can you conclude about the relationship between current and resistance, if voltage is constant? Refer to your measurements for **10V** in Tables 2-1, 2-2 and 2-3 to support your answer.

5. Can the relationships discussed in Questions 3 and 4 be represented as a mathematical expression? If yes, what is that equation?