SCI 150

Electricity

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Lab 3

Purpose of the experiment

Verifying **Ohm's law** through demonstrating the relationship between the **current and voltage** across a **resistance** in a complete circuit.

Demonstrating the **deviation from Ohm's law**.

Principle

At a constant temperature of a conductor, the amount of the current (I) passing through the conductor is directly proportional to the voltage (V) across the conductor, and inversely proportional to its resistance (R).

$$I = \frac{V}{R}$$ **(Ohm's law)**

However, at high resistance, deviation occurs from this linear relationship.

What is electricity?

Electricity in its simplest definition is the *flow of electrons in a conductor*.

The speed of electricity is the same as the speed of light (approximately 300,000,000 m/s).

Electricity encompasses 3 main parameters

❑ **The flow of electric current**, and is measured in **amperes** (amp).

One ampere = a flow of one Coulomb (unit of charge) per second.

❑ **The force** that pushes the electric current in a conductor, known as the potential difference or voltage across the conductor, and is measured in **volts**.

- The potential difference between the two holes of the home outlets is 220 volts. When the prongs of a plug are inserted into an outlet, an electrical pressure of 220 volts is placed across the circuit connected to the prongs.

Electricity encompasses 3 main parameters

❑ The **resistance** produced by the conductor to the flow of electric current, and is measured in **ohms**.

Resistance is associated with 2 main factors:

❑ The length of the conductor: Considering an electric current passing in a wire, the greater the length of the wire, the higher the resistance to the flow of the electrons.

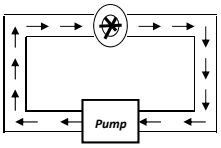
❑ The cross section of the conductor: the smaller the cross section of the wire (i.e. the thinner the wire), the more difficult it becomes for the electrons to flow, and therefore the higher the resistance.

To clarify what electricity is, a closed water system model will be used to compare its behavior to that of electricity:

Water versus electricity

Water

- The water needs a pump to make it move.



- The water needs pipes to move through the circuit, with a pressure difference between the ends of the pipes.

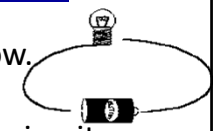
- The amount of water flowing through the circuit depends on the resistance offered by the walls of the pipes.

- No water is used up as it moves around the circuit.

- The water can turn the water wheel because of the energy given to it by the pump.

Water versus electricity

Electricity



- The electricity needs a battery or cell to make it flow.

- Electricity needs a metal wire to move through the circuit, with a voltage difference between the ends of the wire.

- The amount of electric current flowing through the circuit depends on the resistance offered by the wires.

- None of the electricity is used up as it moves around the circuit.

- The electricity lights the bulb because of the energy given to it by the battery.

What makes a light bulb lights?

The light bulb filament is a very thin wire.

Consequently, **its resistance is high**.

All the electrons being pushed through the thinner wire of the filament are slowed, crowding in between the metal atoms.

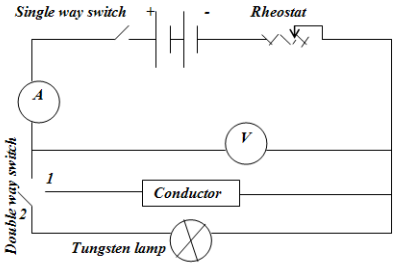
This results in the *metal wire getting hotter and hotter* and eventually radiating white light.

Procedure

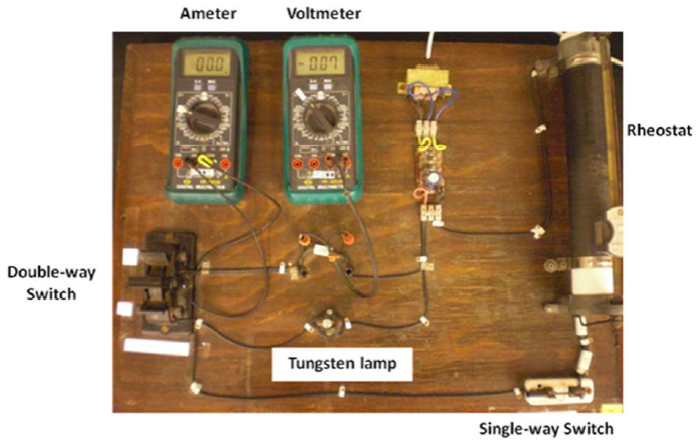
The experiment will be repeated twice with a varying current passing in two separate circuits.

The current and resulting change in voltage are determined using an ammeter and a voltmeter respectively.

From the obtained data, the relationship between the voltage and current in each case will be plotted, the slope of which will be used to calculate the resistance.



Procedure



The electricity setup is composed of rheostat, tungsten lamp, resistance, ameter, voltmeter, single-way switch that is always closed and a double-way switch that will be adjusted manually during the experiment to positions 1 and 2.

Procedure

A. Varying current across a resistor:

1- Adjust the rheostat at maximum resistance (longest wire length), then adjust the double way switch in position 1 to allow the current to pass only through the resistor.

2- Close the single way switch to let the current flow in the circuit. Record the ammeter and voltmeter readings.

3- Gradually increase the current in the circuit through moving the rheostat slider. *This decreases the length of the wire through which the current flows, thus decreasing the resistance and increase the amount of current flowing.*

Procedure

Record the ammeter (I) and voltmeter (V) readings for each change in current, until you get about 10 readings. **Readings recorded in milliamps or millivolts should be converted into amps and volts.**

4- Tabulate your data in table A.

5- Plot a best fit straight line graph between (I) and (V).

6- From the slope of the graph find the resistance (R).

Procedure

B. Varying current across a light bulb:

1- Adjust the rheostat at maximum resistance (longest wire length), then adjust the double way switch in position 2 to allow the current to pass only through the lamp.

2- Close the single way switch to let the current flow in the circuit. Record the ammeter and voltmeter readings.

3- Gradually increase the current in the circuit through moving the rheostat slider. *This decreases the length of the wire through which the current flows, thus decreasing the resistance and increase the amount of current flowing*.

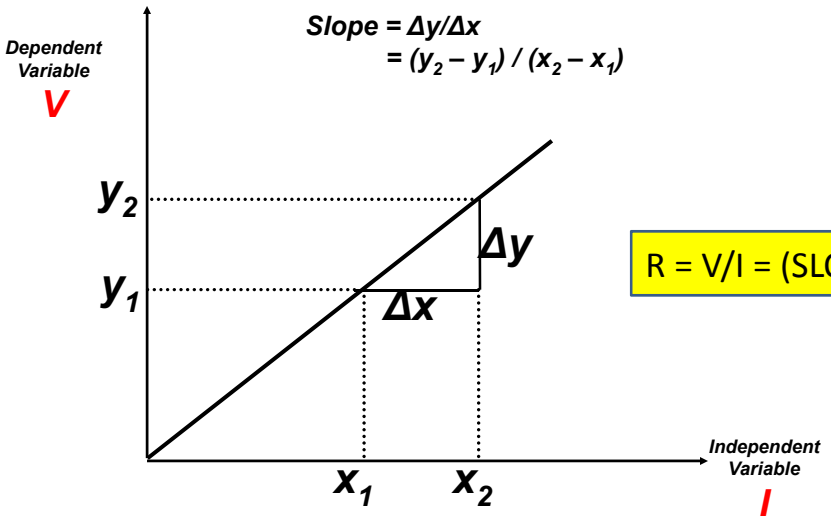
Procedure

Record the ammeter (I) and voltmeter (V) readings for each change in current, until you get about 10 readings. **Readings recorded in milliamps or millivolts should be converted into amps and volts.**

4- Tabulate your data in table B.

5- Plot a best fit straight line graph between (I) and (V).

6- From the slope of the graph find the resistance (R).


Slope = Δy/Δx
= (y2 – y1) / (x2 – x1)
Dependent Variable
V
y2
y1
Δy
Δx
x1
x2
Independent Variable
I

R = V/I = (SLOPE)