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Methodology

We begin by describing the methodology of our test the linear relationship between voltage and current in electrical circuits modelled by Ohm's law:

$$1. \quad V = IR$$

A loop circuit was constructed using a power source, an ammeter connected in series, a resistor, and a voltmeter connected in parallel, as shown schematically in Figure 1. The resistance was set manually to 100 ohms and was kept constant. The voltage is the independent variable; it was set manually to 0.452V and was increased by 0.010V 19 times until a final value of 0.652V was obtained. At each voltage, the dependent current was recorded. Once all values were measured and recorded, the resistance was measured using one of the multimeters; this value was recorded. Measurements of voltage and current were repeated for a potentiometer. Again, 20 measurements were conducted and resistance was measured at the end of all trials.

Materials:

- Keysight Triple Output Programmable DC Power Supply
- 2 Keithley 130A Multimeters
- University of Toronto- Department of Physics LCR Breakout Box

Uncertainties are determined using the methodology layed out in the user manual for the Keithley 130A Multimeters. For a reading of magnitude A, the uncertainty calculation generally takes the form of

$$2. \quad \pm (Ax + NR)$$

where x is a specified percentage of the reading's magnitude, and N is a specified number of counts of the machine's resolution, R. For example, to calculate the uncertainty of a voltage reading of 0.452 V:

$$3. \quad \pm ((0.452)(0.25\%) + (1)(1 \times 10^{-3})) = \pm\ 0.002V$$

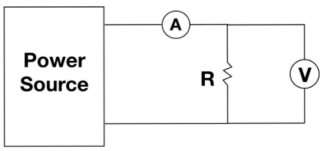

Figure 1. *Diagram of experimental setup. Resistor and ammeter are connected in series and a voltmeter is connected in parallel at both ends of a resistor.*

Next, a description of the methodology for observing the power law for blackbody radiation by plotting a voltage-current graph for a lightbulb.

A loop circuit was constructed using a power source, an ammeter connected in series to a lightbulb, and a voltmeter connected in parallel, as shown schematically in Figure 2. The voltage is the independent variable; it was set manually to 0.00V. Once the voltage and current had stabilised, it was increased by 0.10V 14 times until a final value of 1.40V was obtained. At each voltage, the dependent current was recorded. Once all values were measured and recorded, data was interpreted using python and the resulting graphs were analysed.

Materials:

- Keysight Triple Output Programmable DC Power Supply
- 2 Keithley 130A Multimeters
- Incandescent lightbulb

Uncertainties were calculated in the same way as in the Ohm's law portion of this lab, as the same multimeter was used throughout (see text prior to Figure 1 for uncertainty methodology).

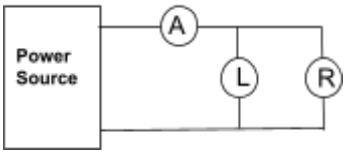

Figure 2. *Diagram of circuit experimental setup; note that an unconventional symbol is used to denote the light bulb, "L".*