UNIVERSITY OF WOLLONGONG IN DUBAI

LAB REPORT 2

INTERNAL RESISTANCE AND ELECTRICAL METERS

Subject: PHYS143 (DB123) Physics for Engineers.

Group Members:

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Experiment 1
Meter Internal Resistance Measurement

Purpose

The objective of this experiment is to understand how a decade box works and to measure the internal resistance of the meter.

Hypothesis

When the decade box is connected in parallel, half of the current will go through the ammeter and the rest will go through the decade box hence giving us a value of the internal resistance.

Materials used

- Power supply
- 100k Ohms resistor
- Resistance box/Decade box
- Multimeter/Ammeter
- Power supply wires
- Meter probes
- Banana cables
- Bread board
- Wires.

Procedure

1. Set up the wires on the bread board and connected the resistor and ammeter according to the circuit diagram given in the handout.
2. Connect the power supply wires from the power supply to the wires on the bread board.
3. Set the voltage at 10V and read the current on the multimeter/ammeter.
4. Connect the decade box to the circuit in parallel to the ammeter and adjust the resistance on the decade box so that the reading of the current is half of the previous reading.
5. Determine the resistance from the decade box.

Data and Observations

Before connecting the decade box, Voltage was set to 10V, the reading of the current on the ammeter was 104.8 μA. After connecting the decade box in parallel to the ammeter and setting the current on the ammeter to 52.4 μA which is half of the first reading (104.8 μA). We then observed the resistance on the decade box and got 498 Ω.

Conclusion

We had to find the internal resistance of the meter. We made a circuit on the bread board. Then we set the voltage on the power supply at 10V and read the current on the ammeter. We then connected the decade box to the circuit in parallel to the meter and set the current to half the value of the previous reading. Then we determine the resistance form the decade box. Some sources of errors could include;

1) Improper connection of wires.
2) Human error could have affected the values.
3) Multimeter/ammeter may not be calibrated.

We learnt that we can find the internal resistance of the meter using a decade box by setting the resistance on the decade box such that half of the current flows through the ammeter and the rest flows through the decade box. If we redo this experiment, we would take more readings for current to be on the safe side with more accurate readings.

Experiment 2
Wheatstone bridge

Purpose:

The goal of this experiment was to calculate the resistance of the unknown resistor.

Hypothesis:

We expect R_x (value that we calculated) to be similar to the theoretical value of the resistor.

Materials used

- Power supply
- 2 resistors
- slide wire
- Ammeter
- 6 banana cables
- Meter probes
- Wires
- Bread board.

Procedure

1. Connect the wires and a fixed resistor of 22,000 Ω
2. Connect an unknown resistor on the bread board.
3. Connect the power supply to the slide wire using banana cables.
4. Connect the ammeter to the circuit with meter probes.
5. Next connect the circuit to the slide wire using meter probes.
6. To get a zero current on the ammeter move the slider on the slide wire and read the length (L_1) on the slide wire
7. Repeat this experiment for 3 unknown resistors.

Data and observation

R (Ω)	L_1 (cm)	L_2 (cm)	R_x (Ω)	R_t (Ω)	Percentage error
22000	9.1	90.9	2202.4	2200	0.11
22000	7.55	92.45	1796.6	1800	0.19
22000	12.97	87.03	3278.6	3300	0.65

Calculations

$$L_2 = 100 - L_1$$

$$R_x = (R*L_1)/L_2$$

$$\text{Percentage error} = (R_t - R_x)/R_t$$

Conclusion

We need to find the resistance of 3 unknown resistors. We made a circuit with a fixed resistor of resistance 22,000 Ω and connected an unknown resistor. We connected the power supply to the slide wire with some banana cables and connected the ammeter to the circuit with meter probes. we moved the slider on the slide wire until the ammeter showed us a reading of 0A and then we read the length (L_1). This experiment was repeated for 2 more resistors.

Some possible sources of error;

1) Parallax error when taking L_1 values.
2) Improper calibration of the ammeter.
3) Improper connection of wires and resistors.
4) The wire on the slide wire may not be smooth.

We learned that resistance is proportional to the length and that we can find the resistance of an unknown resistor if we know the resistance of the other 3 resistors. Reading the value of L_1 perpendicularly would give us more accurate results.

Experiment 3
Resistivity of a wire

Purpose

The objective of this experiment was to find the resistance of the wires on the resistance apparatus. We then used the resistance to calculate the resistivity of the wires.

Hypothesis

A wire with a smaller resistance and/or a wire with a smaller diameter would have a smaller area resulting in a smaller resistivity since resistivity depends on area. It is also indirectly proportional to the length but in this case the length of the wires is all the same.

Materials used

- Ohmmeter
- Probe wires
- Resistance apparatus.

Procedure

1. First connect the probe wires to the ohmmeter and the apparatus
2. Read the value of the resistance for the 5 wires (the 2nd and 3rd wires are the same so we experimented on the 2nd wire).

Calculations

To calculate the resistance, subtract the reading on the ohmmeter with the error of the ohmmeter. Use the formula $\rho = \frac{RA}{L}$ to find the resistivity of every wire on the apparatus.

Data and observation

Material	Resistance (Ω)	Radius (10^{-4} m)	Length (m)	Resistivity (10^{-7} Ω/m)
Constantan	1.2 - 0.3 = 0.9	5	1	7.07
Constantan	1.7 - 0.3 = 1.4	3.5	1	5.39
Constantan	2.8 - 0.3 = 2.5	2.5	1	4.91
Constantan	5.3 - 0.3 = 5	1.75	1	4.81
Brass	0.6 - 0.3 = 0.3	2.5	1	0.589

The resistivity of all the constantan types is higher than brass. Even when brass has a larger radius, it still has a lower resistivity than constantan.

Conclusion

In this experiment we had to find the resistivity 5 different wires. We are given 5 different wires (4 Constantan wires and 1 Brass wire) that are fixed onto a Resistance Apparatus. The wires vary in diameters but are of the same length (each being 1 meter in length). First, we attach the wires from the ohmmeter to the resistance apparatus. The ohmmeter displays the resistance of the wire. To determine the resistance of the provided wire, we take the resistance values from the ohmmeter and plug them into the equation $\rho = \frac{RA}{L}$.

Some sources of error;

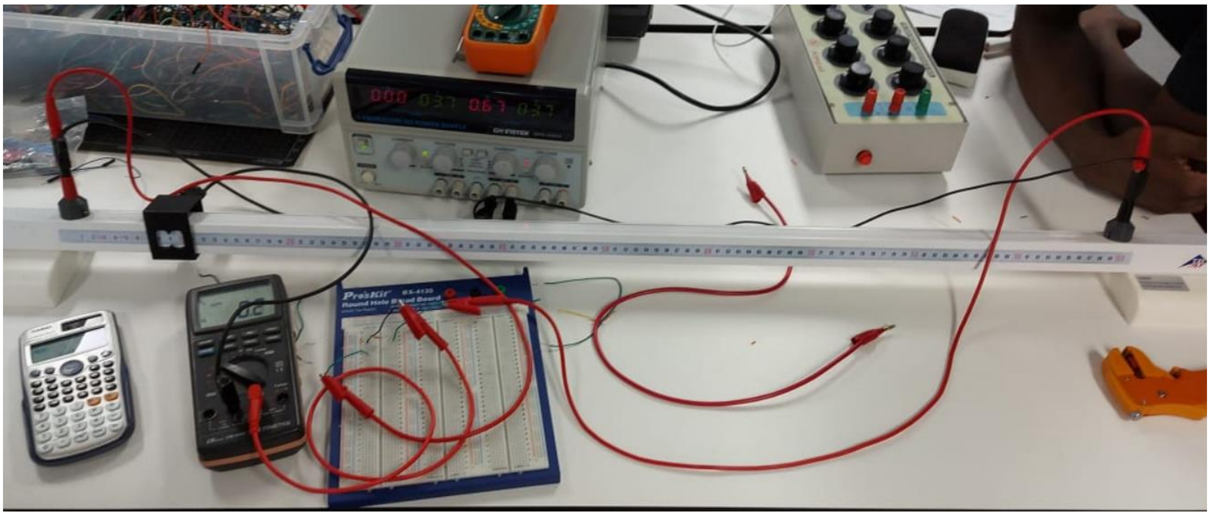
1) Improper calibration of the ohmmeter.
2) Connections of the meter probes on the wire should be done at the very end of the wires because resistance is directly proportional to the length.
3) The wires may have an uneven surface.

We learnt that the multimeter may have some error in itself. If we repeated this experiment, we would take more values of resistance to be more accurate.

Pictures of experiments

Experiment 1

Experiment 2



Experiment 3