NILE UNIVERSITY OF NIGERIA

HONORIS UNITED UNIVERSITIES

**Faculty of Natural and Applied Sciences**
**Department of Physics**

# PHY 108
# Electricity, Magnetism Experiments

## Experiment 1: Measurement of Small Resistance

**STUDENT NAME:**

**STUDENT ID:**

**DEPARTMENT:**

**DATE OF EXPERIMENT:**

**GROUP:**

**OBJECTIVES:**

Determination of the resistances of various DC conductors by recording the current/voltage characteristics.

Determination of resistivity of metal rods and contact resistance of connecting cords.

**EQUIPMENT NEEDED:**

Universal measuring amplifier 13626-93 1
PHYWE Power supply 0-12 V DC/ 6 V, 12 V AC, 230 V 13505-93 1
Heat conductivity rod, Cu 04518-11 1
Heat conductivity rod, Al 04518-12 1
Digital multimeter 2005 07129-00 2
Connection box 06030-23 1
Connecting cord, 32 A, 2000 mm, yellow 07365-02 2
Connecting cord, 32 A, 750 mm, yellow 07362-02 2
Connecting cord, 32 A, 750 mm, blue 07362-04 1
Connecting cord, 32 A, 500 mm, red 07361-01 2
Connecting cord, 32 A, 500 mm, blue 07361-04 1
Connecting cord, 32 A, 250 mm, red 07360-01 1
Connecting cord, 32 A, 250 mm, blue 07360-04 1
Connecting cord, 100 mm, yellow 07359-02 2

**THEORETICAL BACKGROUND:**

The resistivity of the metal is determined from the resistance R of the rod and its dimensions. The rod has a diameter of 2.5 cm (Cross-sectional Area = $4.91 \times 10^{-4}$ $m^2$) and is 31.5 cm long (length l) between the two voltmeter connections.

$$\rho = \frac{R \times A}{l}$$
$$v = IR$$

**PROCEDURE:**

**I**

1. The experiments should be set up as shown in the first diagram
2. The Power supply, Conducting Rod, and Ammeter are all connected in series
3. The Amplifier and the Voltmeter are both connected in parallel across the Conducting Rod
4. The length of the Conducting Rod is varied (from 0mm to 320mm) as the corresponding voltage drop across the length of the conductor is measured with the voltmeter and recorded
5. Subsequently, fix the length of the Conducting Rod at 320mm and then vary the power supply from 0.2A to 2.0A, Read and record the corresponding Voltages. Settings of the amplifier: Low drift, R = $10^4$ Ω, Amplification: $10^3$, Timer constant: 0 sec.
6. The procedure is repeated for both Copper and Aluminum conductors respectively.
7. Plot the graph of V against I for both Aluminum and Copper.

**II**

1. The experiment is set up as indicated in the diagram by connecting each of the three different cords of varying length to the mains through the connecting box.
2. An ammeter and a voltmeter is connected in series and parallel respectively
3. Measure and record the voltage drop across each of the connecting cords via the voltmeter as the current is varied from 0.3A to 2.1A (see Fig. II).

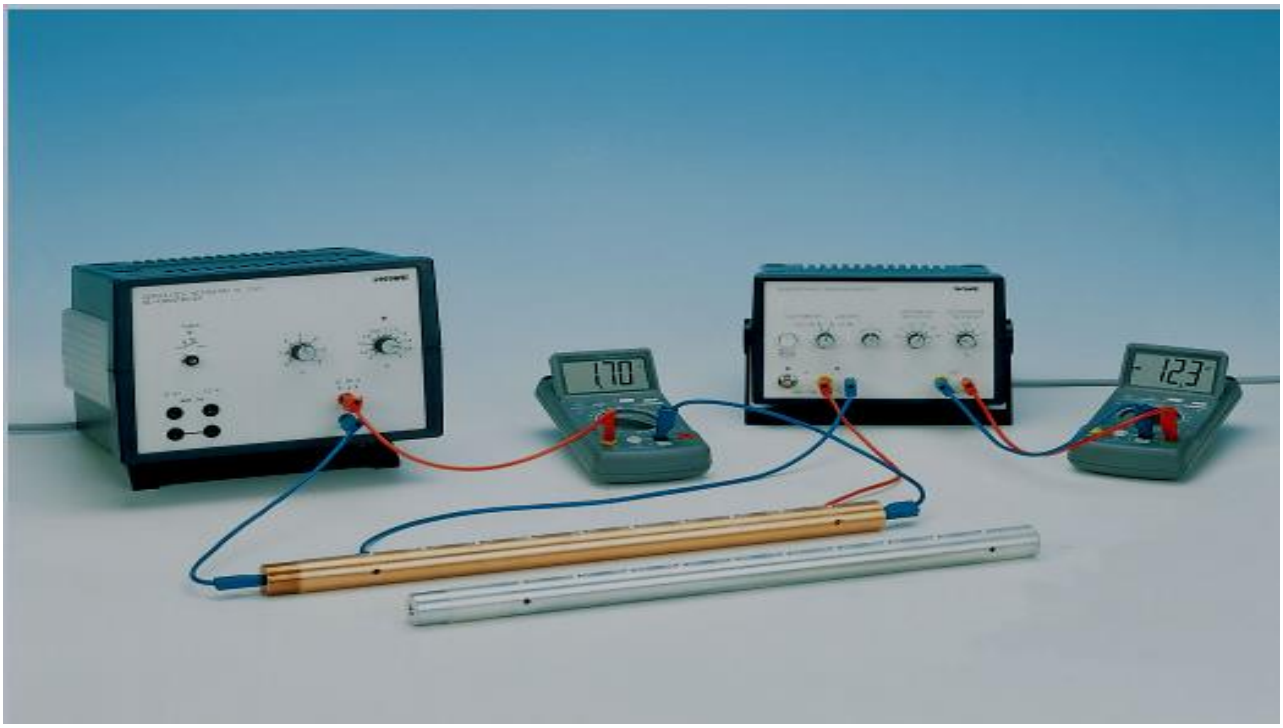

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**Figure I: Experimental setup for measuring small resistance**

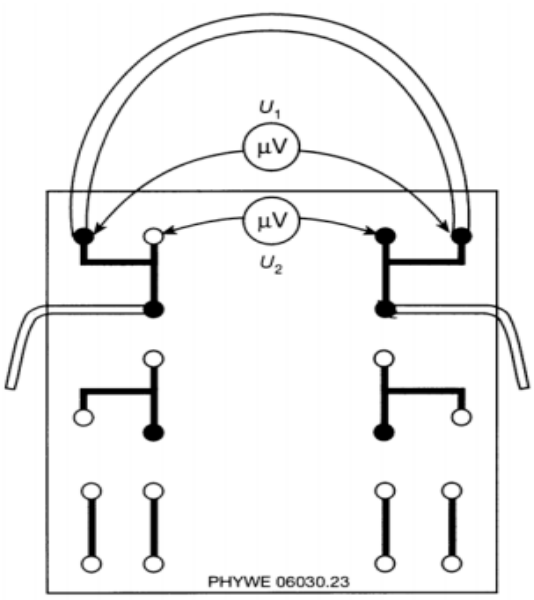


**Figure 1: Measuring the contact resistance and resistivity of connecting cords**

## DATA: For Aluminium rod

| S/N | Length(mm) | Voltage (V) |
|---|---|---|
| 1 | 0 | |
| 2 | 35 | |
| 3 | 70 | |
| 4 | 105 | |
| 5 | 140 | |

| | | |
|---|---|---|
| 6 | 175 | |
| 7 | 210 | |
| 8 | 245 | |
| 9 | 280 | |
| 10 | 320 | |

| S/N | Current (A) | Voltage (V) |
|---|---|---|
| 1 | 0.2 | |
| 2 | 0.4 | |
| 3 | 0.6 | |
| 4 | 0.8 | |
| 5 | 1.0 | |
| 6 | 1.2 | |
| 7 | 1.4 | |
| 8 | 1.6 | |
| 9 | 1.8 | |
| 10 | 2.0 | |

**For Copper Rod**

| S/N | Length(mm) | Voltage (V) |
|---|---|---|
| 1 | 0 | |
| 2 | 35 | |
| 3 | 70 | |
| 4 | 105 | |
| 5 | 140 | |
| 6 | 175 | |
| 7 | 210 | |
| 8 | 245 | |
| 9 | 280 | |
| 10 | 320 | |

| S/N | Current (A) | Voltage (V) |
|---|---|---|
| 1 | 0.2 | |

| | | |
|---|---|---|
| 2 | 0.4 | |
| 3 | 0.6 | |
| 4 | 0.8 | |
| 5 | 1.0 | |
| 6 | 1.2 | |
| 7 | 1.4 | |
| 8 | 1.6 | |
| 9 | 1.8 | |
| 10 | 2.0 | |

**For the different lengths of connecting cords.**

| | RED CHORD Length= | | | BLUE CHORD Length= | | | YELLOW CHORD Length= | | |
|---|---|---|---|---|---|---|---|---|---|
| S/N | Current I (A) | Voltage V (V) | Resistance R(Ω) | Current I (A) | Voltage V (V) | Resistance R(Ω) | Current I (A) | Voltage V (V) | Resistance R(Ω) |
| 1 | 0.3 | | | 0.3 | | | 0.3 | | |
| 2 | 0.5 | | | 0.5 | | | 0.5 | | |
| 3 | 0.7 | | | 0.7 | | | 0.7 | | |
| 4 | 0.9 | | | 0.9 | | | 0.9 | | |
| 5 | 1.1 | | | 1.1 | | | 1.1 | | |
| 6 | 1.3 | | | 1.3 | | | 1.3 | | |
| 7 | 1.5 | | | 1.5 | | | 1.5 | | |
| 8 | 1.7 | | | 1.7 | | | 1.7 | | |
| 9 | 1.9 | | | 1.9 | | | 1.9 | | |
| 10 | 2.1 | | | 2.1 | | | 2.1 | | |

**Instructor signature and Date:_____**

**CALCULATIONS:**

**(a)** Calculate the slope and use the answer to calculate the resistivity of Copper and Aluminium rods.

**(b)** What is the relationship between the length of the connecting cords and the measured voltage?

**(c)** A coil of wire 4 m long has a resistance of 20 Ω. If its resistivity is 108 x 10-8 Ω m, find its area of cross-section

**ERROR ANALYSIS:**

Calculate the percentage error in the resistivity of Cu and Al if the theoretical values are 1.79 x $10^{-8}$ Ω and 2.98 x $10^{-8}$ Ω.

**Title:** **Scale:**

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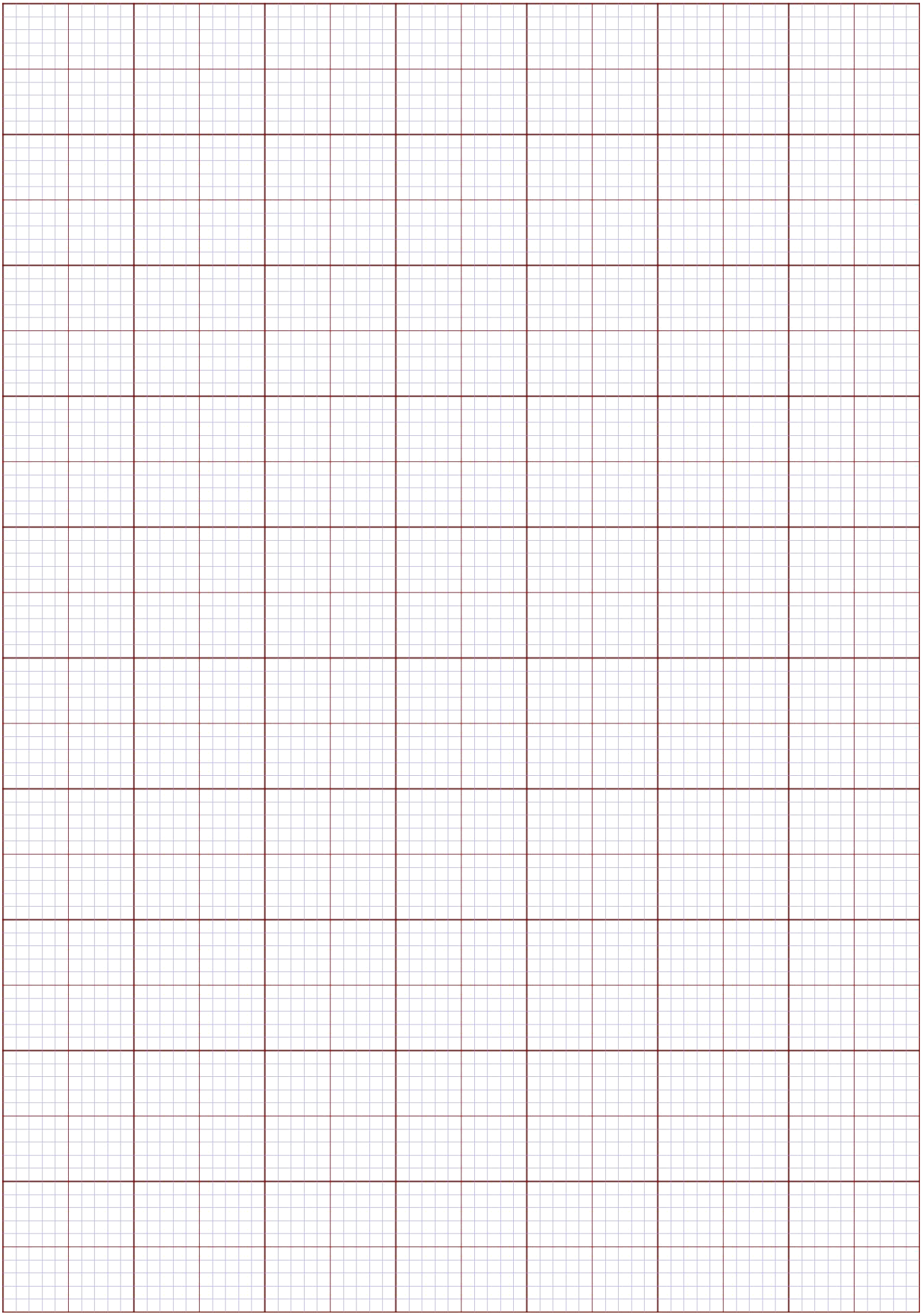

**PRECAUTIONS**

**CONCLUSION AND DISCURSION OF RESULT**

**CALCULATIONS:**

**(a)** Evaluate the slope and calculate the resistivity of both Copper and Aluminum rods.

**(b)** What is the relationship between the length of the connecting cords and the measured voltage?

**(c)** A coil of wire 4 m long has a resistance of 20 Ω. If its resistivity is 108 x $10^{-8}$Ω m, find its area of cross-section

**ERROR ANALYSIS:**

Calculate the percentage error in the resistivity of Cu and Al if the theoretical values are 1.79 x $10^{-8}$ Ω and 2.98 x $10^{-8}$ Ω.