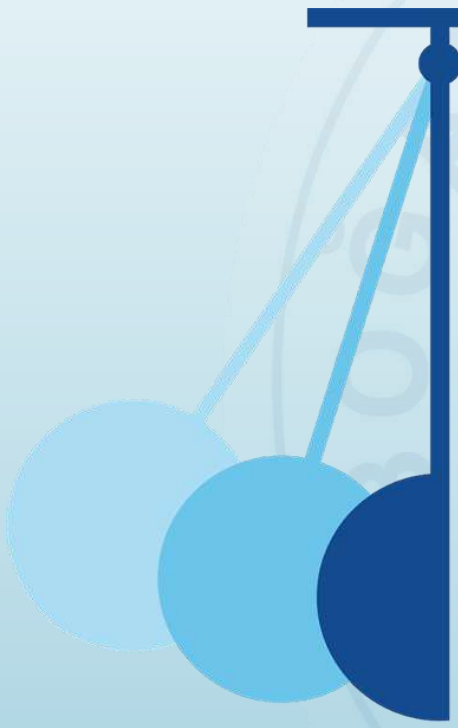


Boğaziçi University

Introductory Phys Labs

MEASUREMENT OF RESISTANCE

–

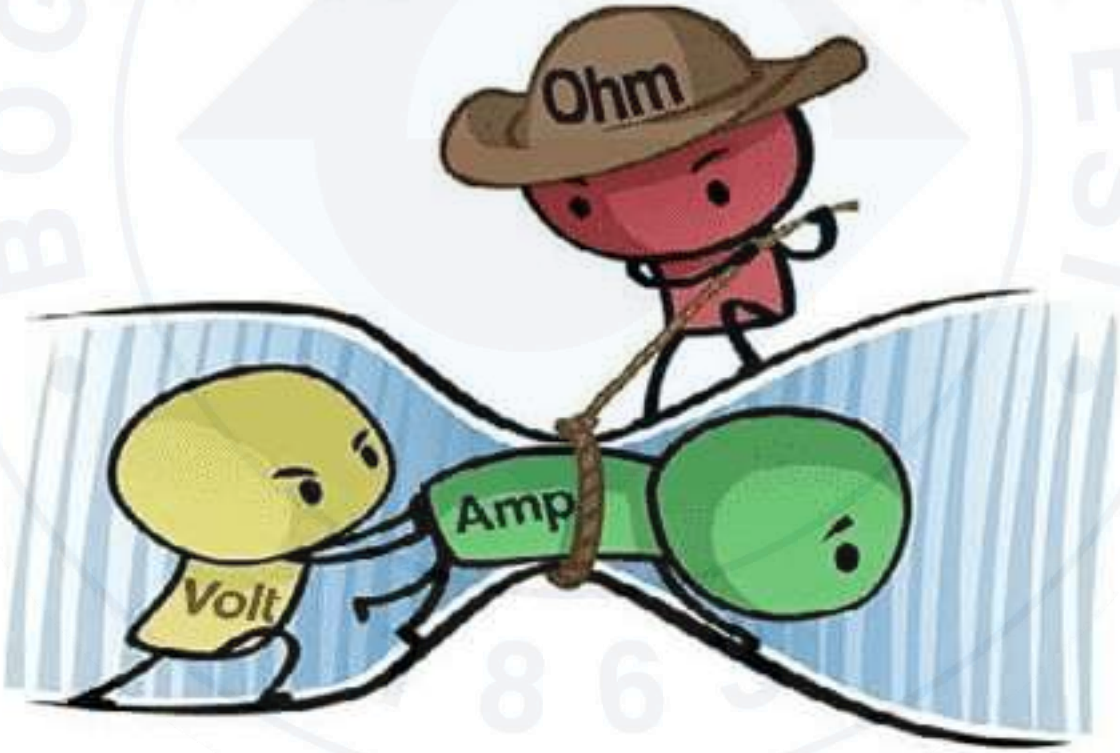
OHM'S LAW

PHYS 201

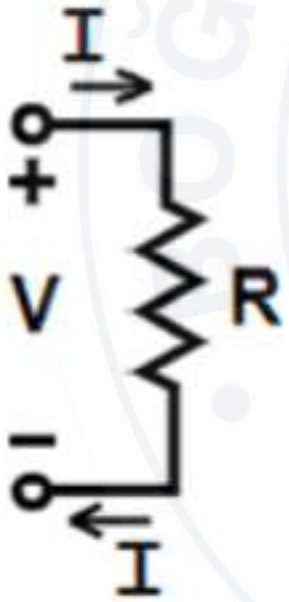
THEORY

MEASUREMENT OF RESISTANCE – OHM'S LAW

At constant temperature, the electrical current flowing through a resistance is directly proportional to the voltage applied across it, and also inversely proportional to the resistance. This relationship between the Voltage, Current and Resistance forms the basis of Ohm's Law and is shown below.



This means, the greater the voltage of the battery, the higher the current will be. Similarly, there will be less current with greater resistance.



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

Where,

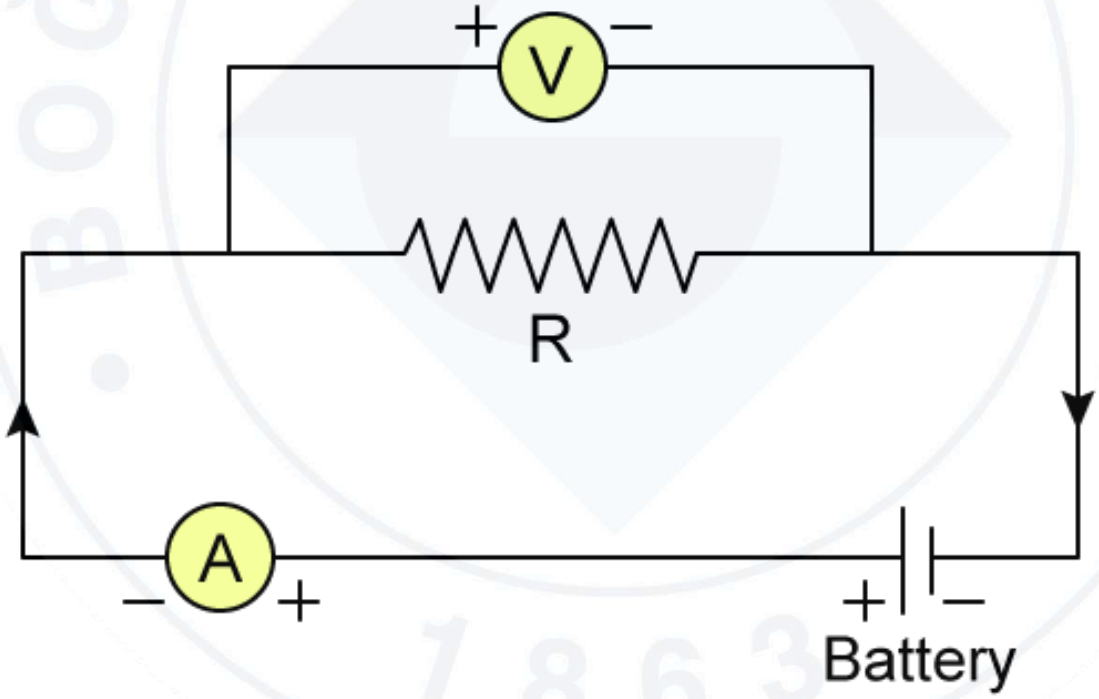
I = Current flowing through the conductor

V = Voltage measured across the conductor

R = Calculated resistance of the conductor. R in this relation is constant and independent of the current.

Understanding Ohm's Law Through A Simple Circuit

Ohm's Law is a simple and useful tool for analyzing electric circuits. It is used often in the study of electricity and electronics.



VOLTMETER

A voltmeter measures the difference in electrical potential between two points in an electric circuit.

A voltmeter is connected in PARALLEL to the device. This is necessary because objects in parallel experience the same potential difference.

In order to get accurate / precise reading, ideally there should be zero current drawn by the voltmeter. That means it should have INFINITE internal resistance.

MEASUREMENT OF RESISTANCE – OHM'S LAW

AMMETER

An ammeter measures the electric current in a circuit. The name is derived from the name for the SI unit for electric current, amperes (A).

An ammeter is connected in SERIES to the device. This is necessary because objects in series experience the same current.

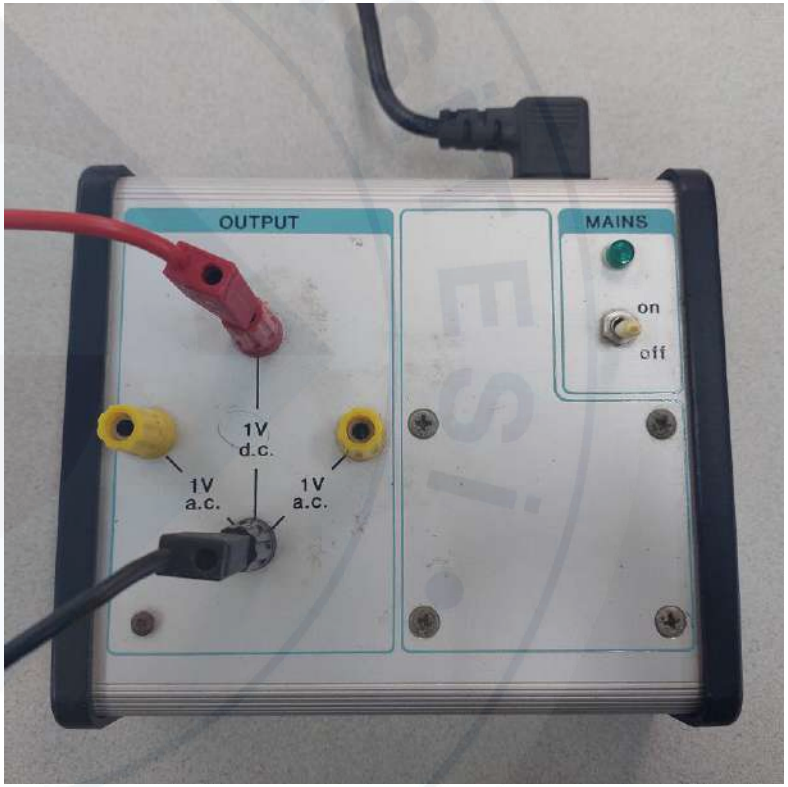
Since an Ammeter is connected in series, in order to minimize any voltage drop across the ammeter that may lead to reduction in source voltage there by reducing the current in the main component, the resistance of an ammeter must be practically ZERO.

DC POWER SUPPLY

DC power supply provides DC electric signal.

Power supplies are devices that deliver electric power to one or several loads.

In direct current (DC), the electric charge (current) only flows in one direction. Electric charge in alternating current (AC), on the other hand, changes direction periodically. The voltage in AC circuits also periodically reverses because the current changes direction.

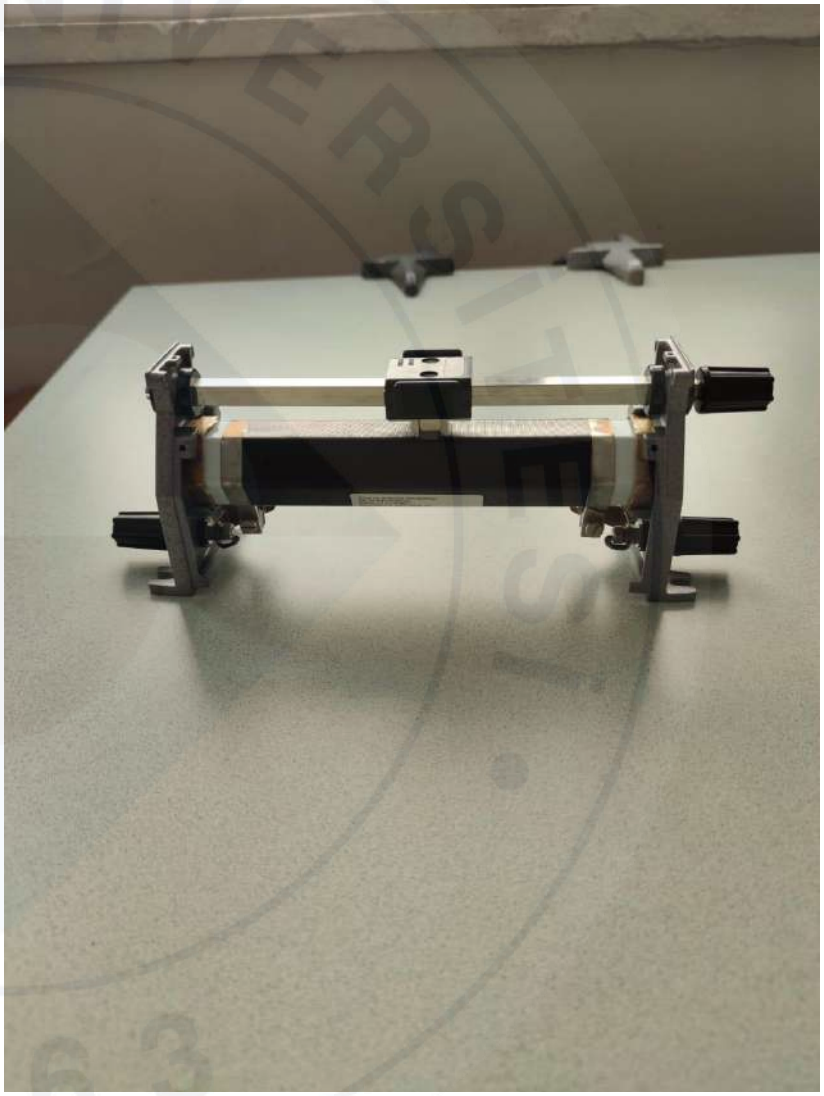


RHEOSTAT

A rheostat is a type of variable resistor.

Rheostat control the flow of electric current by manually sliding a metal connector, i.e. increasing or decreasing the resistance.

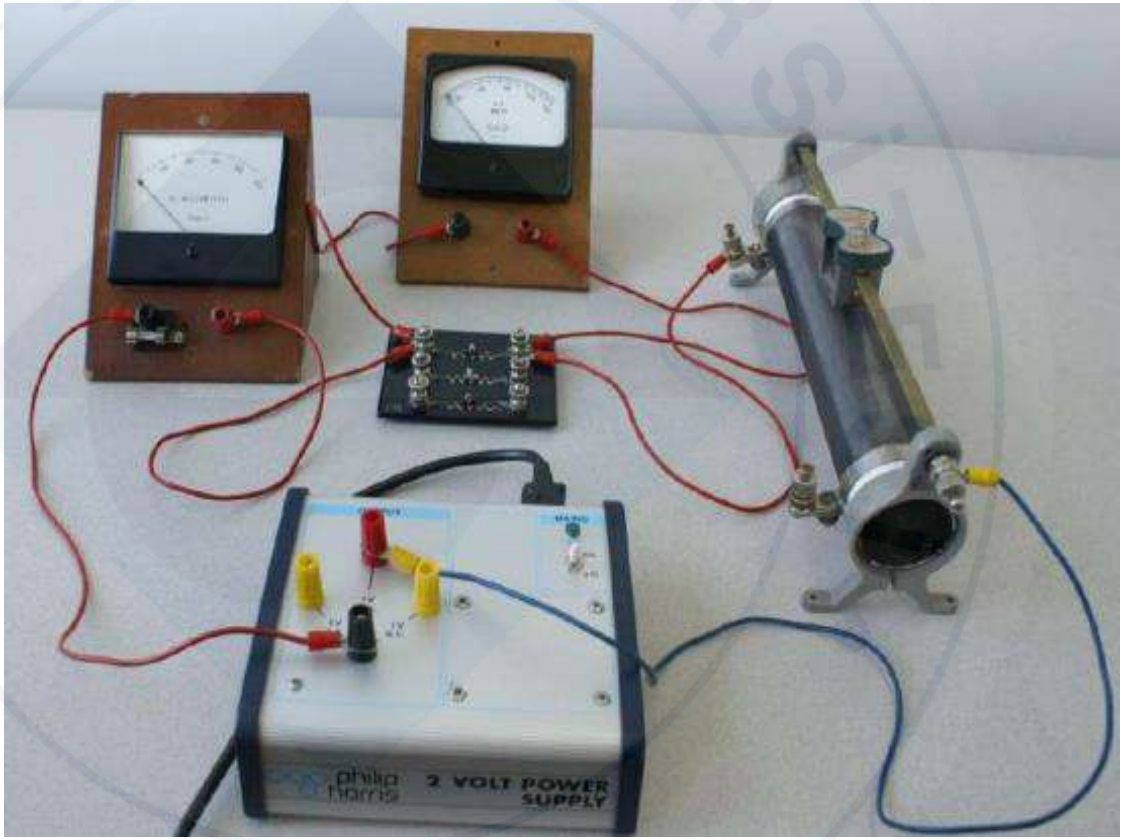
Rheostat can be used as a voltage divider, in order to adjust the potential difference on another circuit element connected to it in series.



EXPERIMENT SETUP

MEASUREMENT OF RESISTANCE – OHM'S LAW

- **Ammeter, DC Power Supply, a Rheostat and Resistance are connected in series.**
- **Voltmeter is connected parallel to the resistance.**



DATA-TAKING

MEASUREMENT OF RESISTANCE – OHM'S LAW

- **The applied voltage is varied by sliding the rheostat and several readings for the current and the corresponding voltage across the conductor are recorded.**
- **There will be ten different measurements.**
- **Read Voltmeter and Ammeter values with a correct number of significant figures and the unit.**

Ammeter has 3 scales.

In this experiment 50 mA scale is used.

Record the Data as shown in the following photographs of the Voltmeter and the Ammeter.

MEASUREMENT OF RESISTANCE – OHM'S LAW

Fill the table on page 2 of your Lab Report

DATA-TAKING

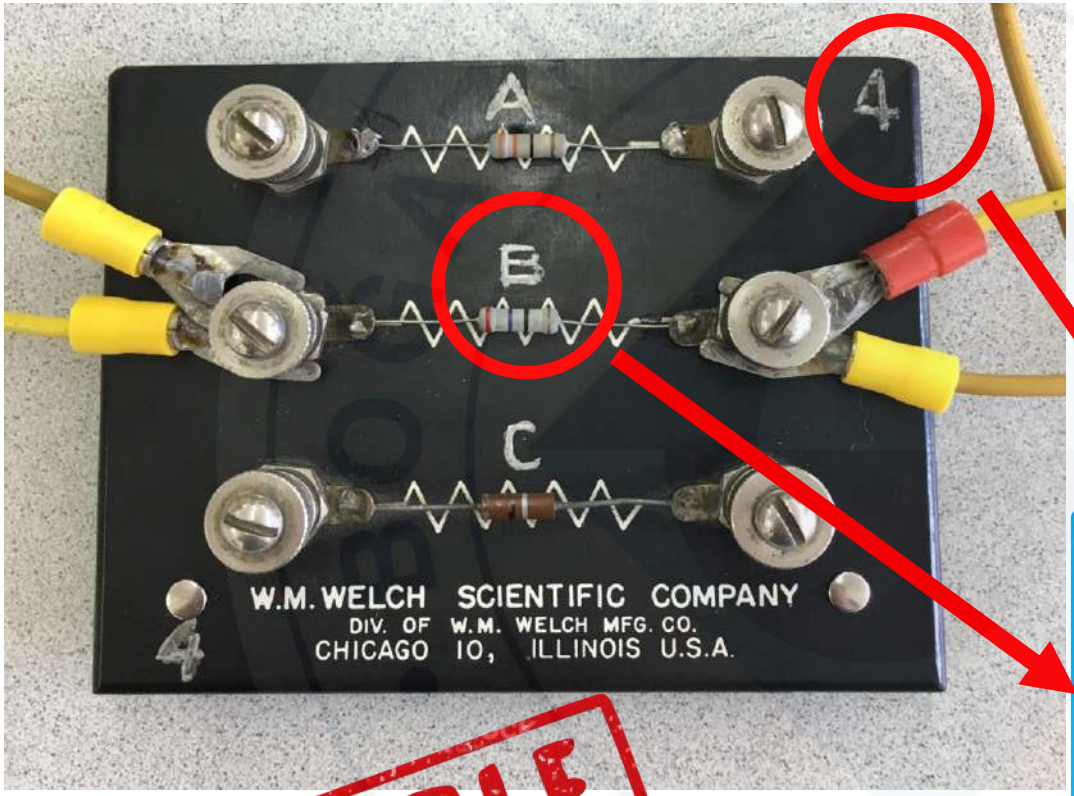
Unknown Resistance Number*	

# of measurements, N	Voltage across the Resistance V ( )	# of Significant Figures :	Current in the Circuit I ( )	# of Significant Figures :
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

SAMPLE MEASUREMENTS

Data on the following slides are intended just for demonstration.

MEASUREMENT OF RESISTANCE – OHM'S LAW



SAMPLE

Unknown Resistance Number:

4B

MEASUREMENT OF RESISTANCE – OHM'S LAW

MEASUREMENT OF RESISTANCE – OHM'S LAW

CALCULATIONS

- **Calculate the corresponding resistance for each voltage-current pair on page 43.**
- **Compute the average and the standard deviation of the resistance.**

The standard deviation formula that you will use to find the standard deviation is shown below:

$$\sigma = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

x is a set of numbers

mean is the average of the set of numbers

n is the size of the set

σ is the standard deviation

MEASUREMENT OF RESISTANCE – OHM'S LAW

$$\sigma = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

3rd and 4th columns give intermediate steps. Do not consider S.F. However, consider the S.F. of the average!

CALCULATIONS

# of measurements, N	R_i ( )	# of Significant Figures :	$R_{average} - R_i$ ( )	$(R_{average} - R_i)^2$ ( )
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
$\sum_{i=1}^{N} (R_i) =$			$\sum_{i=1}^{N} (R_{average} - R_i)^2 =$	
Average of R =			Standard Deviation of R =	

MEASUREMENT OF RESISTANCE – OHM'S LAW

Description	Symbol	Calculation (show each step)	Result

Mean Resistance $R_{average}$ = ...

.....

Standard Deviation of the Resistance Value σ_R = ...

.....

RESULT:

$R = R_{average} \pm \sigma_R$ = ...