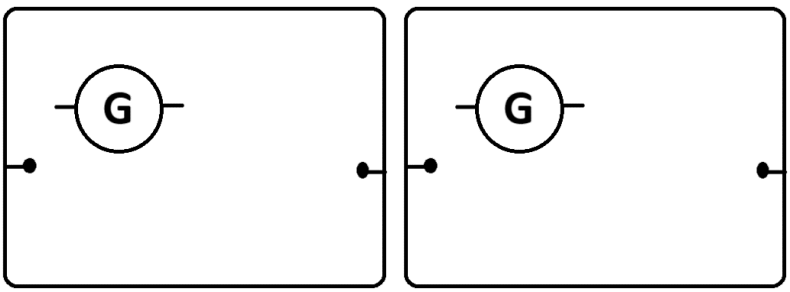
Lab Report

Complete this report YOURSELF except DATA taking parts! This report will not be submitted (except the very last page), but you should carefully complete it as preparation for the applied exam.

Suggested Pre-Lab Questions

Q1. You are given 3 circuit elements: A galvanometer (G) whose internal resistance is R_G, and two resistors R_L and R_S. Their resistance values are related by the following inequality:
$\mathbf{R_L >> R_G >> R_S}$. Using all or some of these circuit elements draws the internal structure of a Voltmeter and an Ammeter respectively.



1

Inside of a Voltmeter **Inside of an Ammeter**

Q2. An ammeter and a voltmeter will be used to measure the current and the voltage across an electric lamp, respectively. If the voltmeter is connected as an ammeter and the ammeter as a voltmeter, what will happen?

Q3. Two resistors, an ammeter and a power supply are connected in series. We know that $R_1 >> R_2$. What happens to the current value on the ammeter when we connect another resistor which has also resistance R_2 parallel to R_2? What happens to the current passing through R_2?

Experiment

OBJECTIVE : To determine the maximum galvanometer current and convert a galvanometer into a voltmeter of a given range.

THEORY : A galvanometer is an instrument used to detect and measure small electric currents. It operates based on the interaction between a magnetic field and an electric current. It is used in analog measuring instruments like ammeters and voltmeters. It detects the presence, direction, and magnitude of current in a circuit. The deflection of its needle (or mirror system) is proportional to the amount of current passing through it.

With modifications, a galvanometer can be used to measure voltage (as a voltmeter) by adding a high resistance in series and larger currents (as an ammeter) by adding a low resistance (shunt) in parallel.

Voltmeters are instruments to measure the potential difference between the two points they are connected in a specific circuit. Ideal voltmeters should have infinite internal resistance so that they do not draw current from the circuit that they are connected. But the real voltmeters have some finite internal resistance.

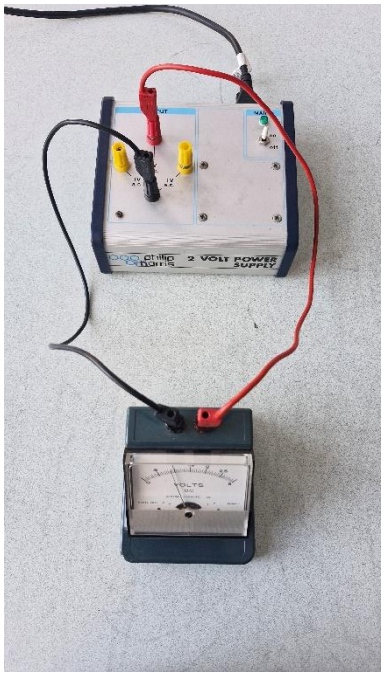
To build a voltmeter we could use a sensitive galvanometer with a very high internal resistance to start with. Since we will be connecting the voltmeter in parallel to any circuit section with a voltage difference up to a maximum value, we should connect a series resistance to the galvanometer. If the full scale deflection is desired to be V, then equating the voltage across the voltmeter to V would give us:

$$I_G R_G + I_G R_{series} = V$$

where I_G and R_G are the maximum galvanometer current and the internal resistance, respectively. We can determine the series resistance from this expression.

APPARATUS : Galvanometer, various wires and resistance boxes, voltmeter and a DC power supply.

PART – 1: DETERMINATION OF THE CONSTANTS OF A GALVANOMETER



You should construct the following two circuits and determine R_1, R_2 and R_G. Apply around 1.0 V, measure it using the voltmeter and note it!

Applied Potential V_{app}=. . . . . .

Attention: For R_1 and R_2 in the circuit, we use two resistance boxes!

1- First construct the first circuit, set R_{box-1} to 9999 ohms, decrease it until you observe Full Scale Deflection (FSD). At FSD, $R_{box-1} = R_1$

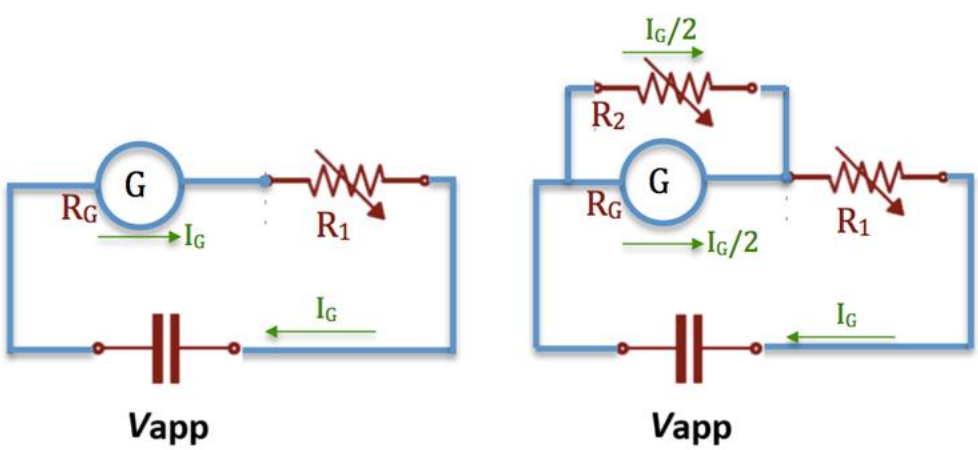
Resistance to set for **FSD** R_1 = ...

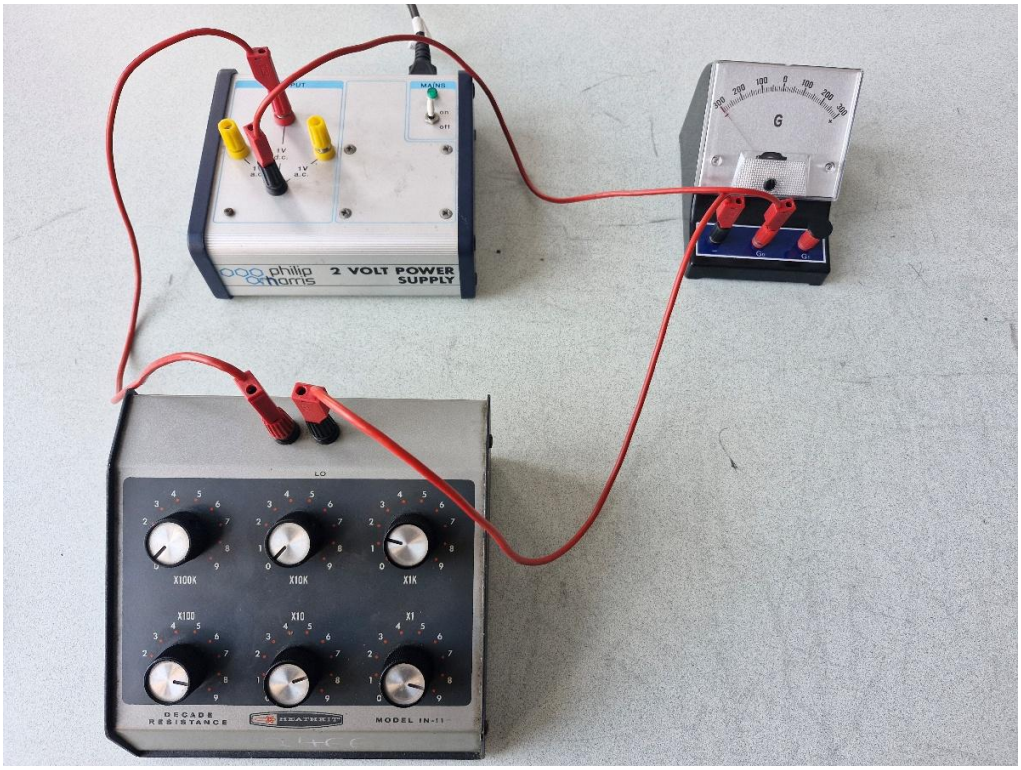
3

2- Then construct the second circuit, set R_{box-2} to 999 ohms (R_{box-1} should be fixed at R_1), decrease it until you observe Half Scale Deflection (HSD). At HSD, $R_{box-2}=R_2$.

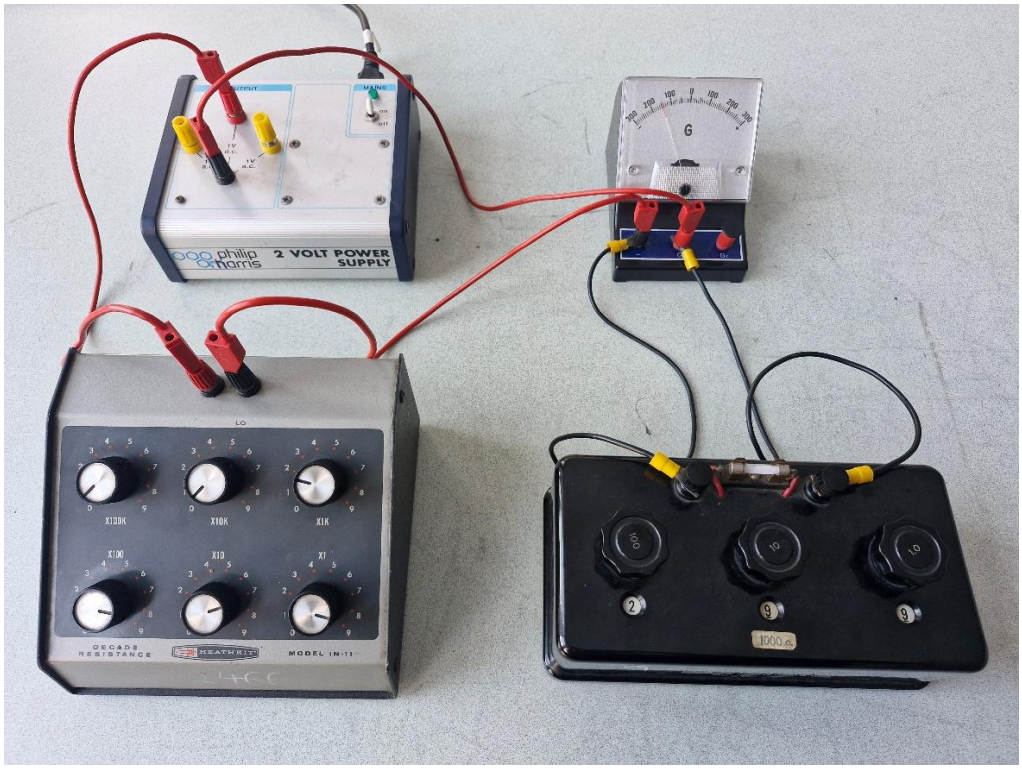
Resistance to set for **HSD** R_2 = ...

Circuits to observe Full Scale Deflection (FSD) and Half Scale Deflection (HSD) respectively.





FSD: Full Scale Deflection (Above)



HSD: Half Scale Deflection (Above)

Description / Symbol	Formula-Calculation /	Value & Unit

Calculate Internal resistance of the Galvanometer R_G = ...

Hint: Make use of the fact that $R_2 << R_1$

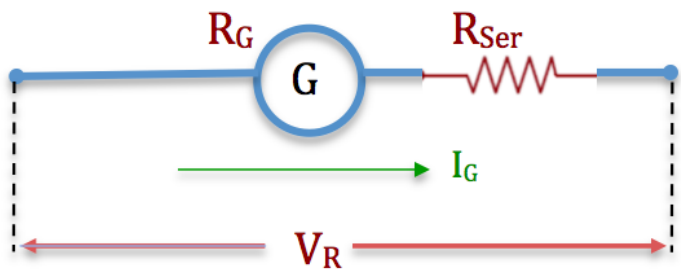
Calculate Max. Galvanometer Current I_G = ...

. . . . . .

PART – 2: CONSTRUCTION OF A VOLTMETER

Circuit of voltmeter (theoretical): Do not construct this circuit. It is drawn so as to make you calculate R_{Ser}.

5



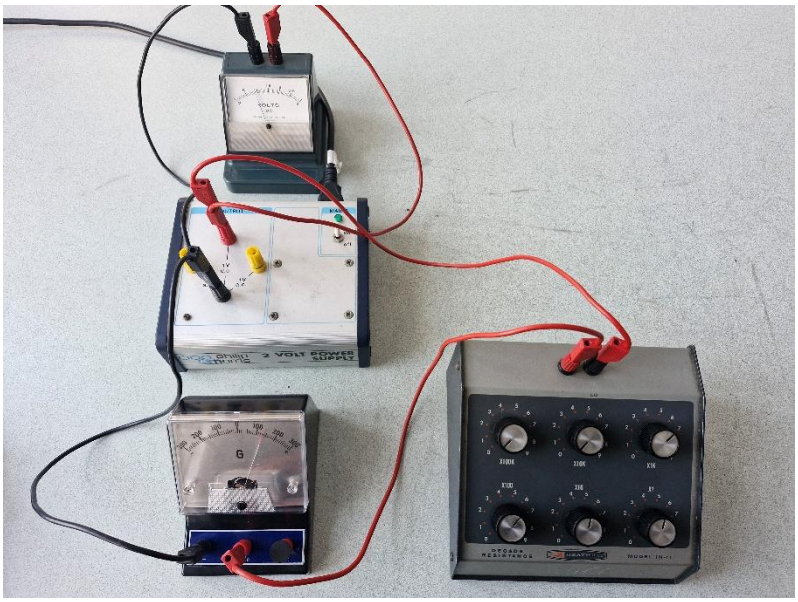
Description / Symbol	Fomula / Calculation	Value / Result

Range for the Constructed Voltmeter V_R = **2.0 V + Table # / 10**

Series Resistance R_{Ser} = ...

. . . . . .

EXP.2: Galvanometers & Voltmeters



Construct a test circuit using the given and constructed voltmeter together with the power supply!

Draw the test circuit in which the constructed voltmeter is used:

Description/Symbol	Value / Calculation	Result
6 Value read from the Galvanometer G_Y =	.....	
Value read from the Constructed Voltmeter V_{EV} =	.....	
Value read from a Real Voltmeter V_{TV} =	.....	

% Error for V:

In the next experiment, which is <u>an applied exam</u>, you will construct an ammeter using similar tools and principles from this experiment.

Post-Lab Report

Aim of the experiment:

Suggestions for possible solutions to the problems experienced during the experiment:

Conclusion:

7 I have completed this experiment myself as specified in the lab sheet and as explained by the lab instructor.

Name & Surname:

Student ID:

Lab Section:

Table #:

Date:

Signature of the student

As the instructor of this Lab Section I confirm that the student has participated in and completed this experiment on time.

Stamp of the PHYS Labs and signature of the instructor

This page serves as proof of the fact that the student participated in and completed the experiment, only if it is submitted in time and accepted by the Lab instructor. The student and the instructor shall sign it along with the stamp of the Physics Laboratories.