Boğaziçi University

Introductory Phys Labs

APPLIED EXAM – 1
AMMETERS

PHYL 201

AMMETERS

AMMETER

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

In general, we do not want to disturb the system when we take measurements. To this end, we connect an ammeter in SERIES. Ideally, an ammeter has ZERO internal resistance, so when connected in series, it will not affect the circuit in any measurable way.

Although the ideal ammeter neither draws power nor reroutes currents, real ammeters necessarily do due to their nonzero internal resistance. Still, typically, the internal resistance is comparatively very low, so we neglect it for all practical purposes.

AMMETERS & UNKNOWN RESISTANCE

GALVANOMETER

The galvanometer is a device that detects an electric current. The value it reads is directly proportional to the current it measures.

The galvanometer has following applications:

- **It is used for detecting the direction of electric current. It also determines the null (zero) point of the circuit, which is when no current flows.**
- **It is used for measuring a very small current.**
- **The voltage between any two points on the circuit may also be determined by a galvanometer.**

VOLTMETER

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

The ideal voltmeter has INFINITE internal resistance, and is connected in PARALLEL to the circuit element across which it measures a potential drop. This way, the voltmeter will not alter the original circuit.

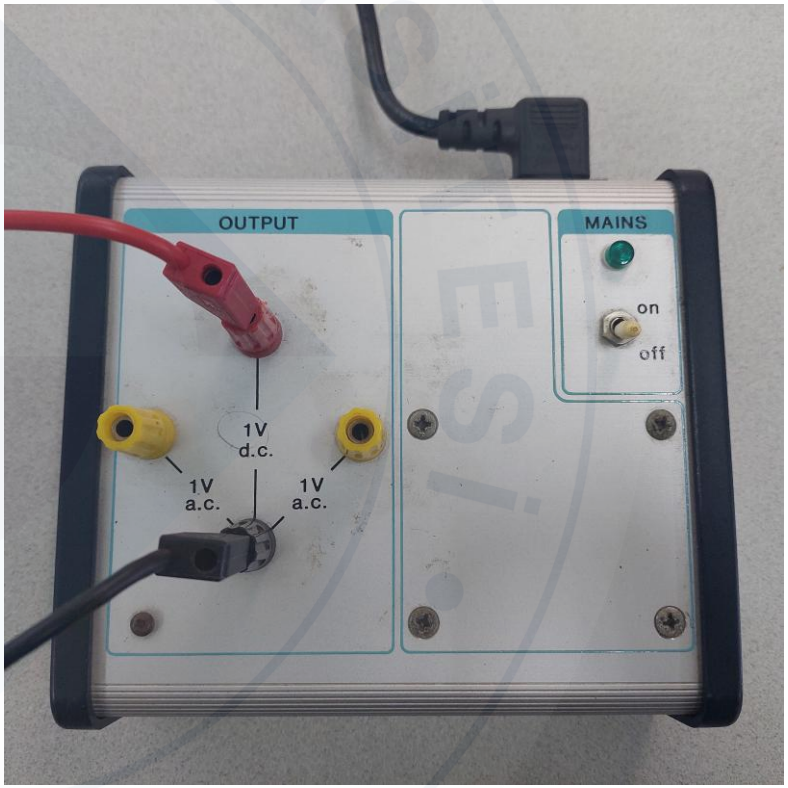
An infinite internal resistance is not realizable, though. However, typically, voltmeters have comparatively very high internal resistances, so we treat them as infinite for all practical purposes.

DC POWER SUPPLY

DC power supply provides DC electric signal.

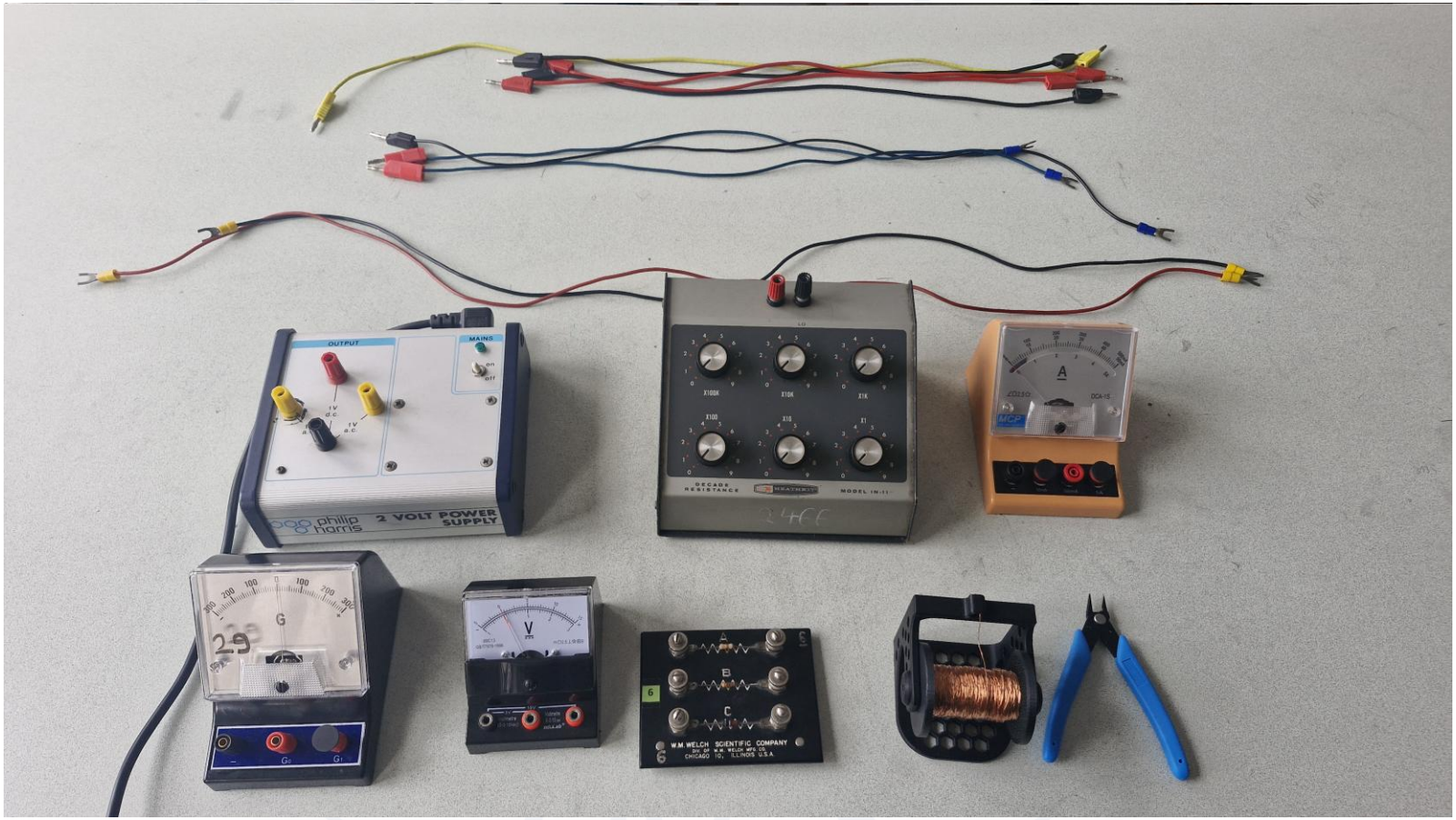
Power supplies are devices that deliver electric power to one or several loads.

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.



AMMETERS & UNKNOWN RESISTOR

The setup consists of 1 V DC power supply, Adjustable resistance box, 500mA ammeter, Galvanometer, 3V DC Voltmeter, Unknown resistor plate, copper cable, flush cutter, connection cables.

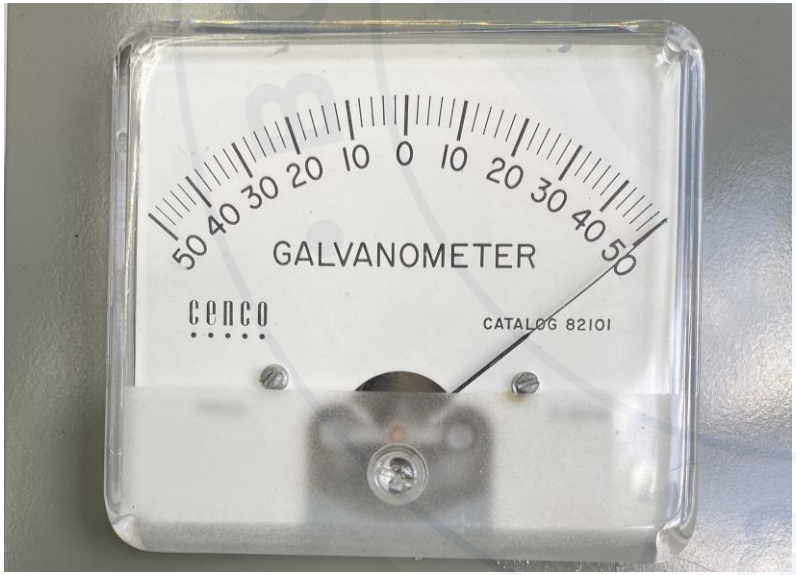


AMMETERS

AMMETERS

In order to build an ammeter, a sensitive galvanometer with an internal resistance of 10-400 Ω is used.

Before we construct our measuring device, we need to know the exact internal resistance of the galvanometer, and what current causes Full Scale Deflection (FSD).



Full Scale Deflection occurs when the pointer shows the maximum value on the scale. Here, the maximum value is 50, and the galvanometer is Full Scale Deflected.

The current causing FSD is called the Galvanometer Current, I_G.

CONSTRUCTION OF AN AMMETER

The internal resistance of the galvanometer (given below the galvanometer) is neither zero nor infinite. So, we cannot use it directly as an ammeter. We must modify the galvanometer to suit our needs.

We will construct an ammeter that measures a maximum of I_R (will be determined on the graph, the value that corresponds to the internal resistance of the galvanometer). That means the galvanometer we use to build an ammeter will Full Scale Deflect when it reads I_R.

We should remember that the galvanometer current, I_G (given below the galvanometer), causes Full Scale Deflection and is <u>much smaller</u> than the range current, I_R.

PART 1: AMMETERS

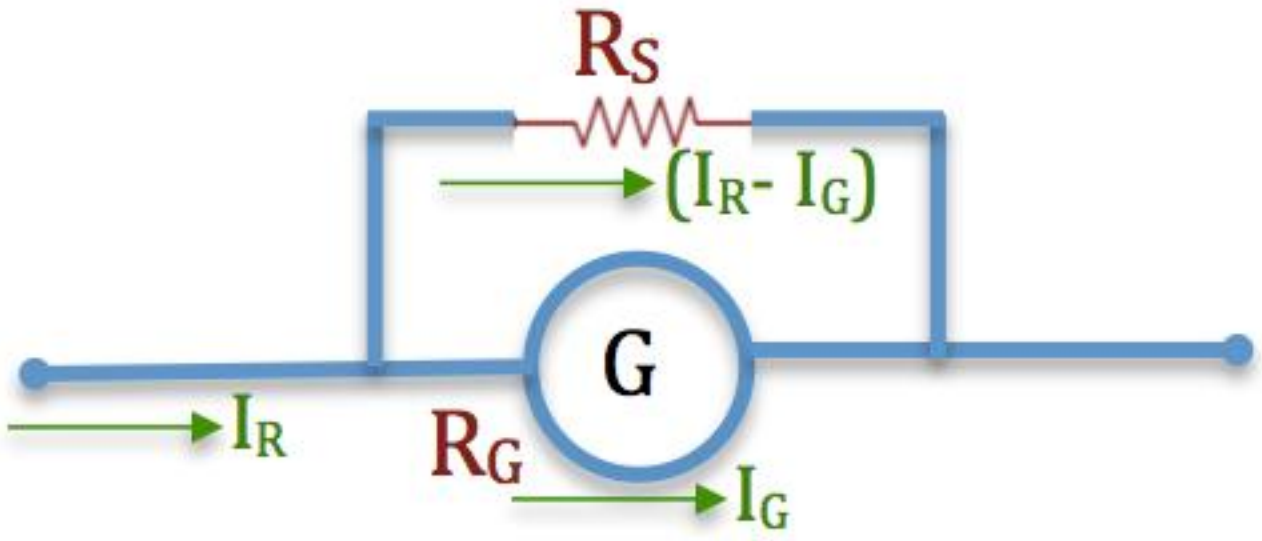
CONSTRUCTION OF AN AMMETER

We will construct an ammeter which measures maximum current of I_R, which will be determined according to the given graph, i.e. I_R vs R_G, on your table.

$$I_R >> I_G$$

Determine the value of R_S, the SHUNT RESISTANCE*, that satisfies this condition.

Hint: Make use of Ohm's Law in the circuit below.

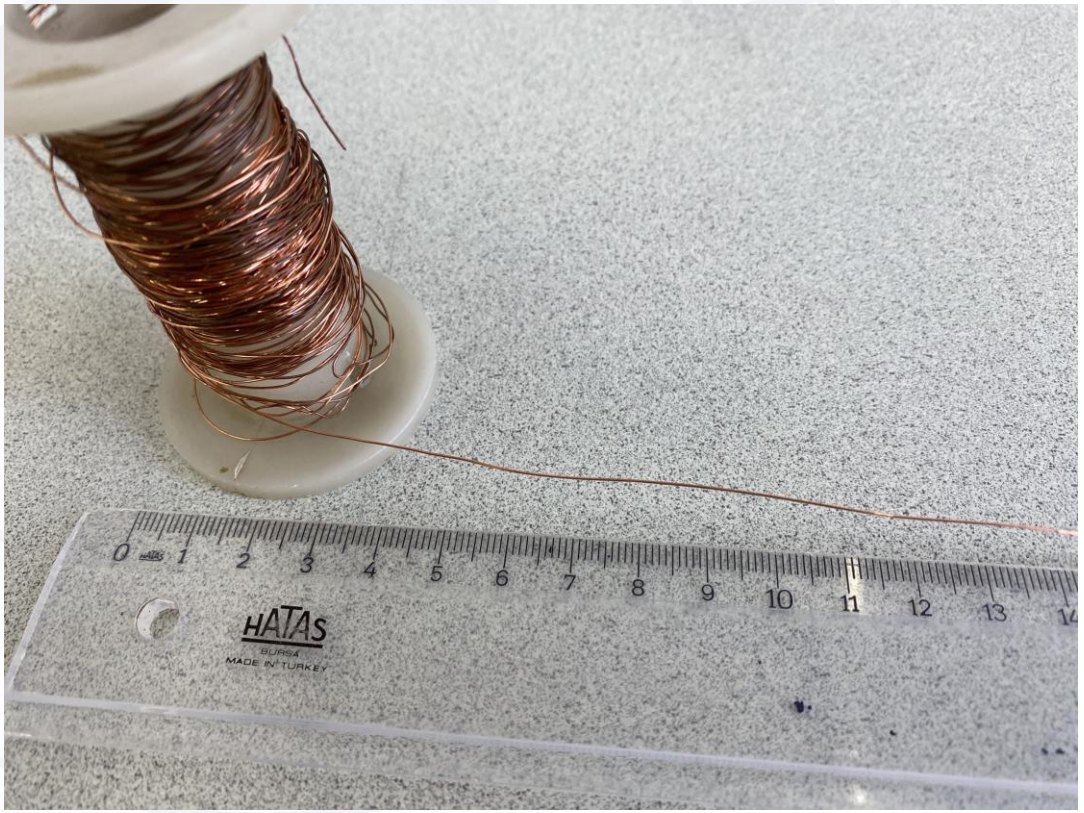


* Shunt means a component used to divert

CONSTRUCTION OF AN AMMETER

Since $R_S << 1\Omega$, we will use as R_S a copper wire with resistance per unit length given on wire holder. Determine the length of the copper wire, L_{CW} ,which will have a resistance R_S.

L_{CW} = ?



CONSTRUCTION OF AN AMMETER

A copper wire with the calculated length is connected in parallel to the galvanometer. This combination is our constructed ammeter, which measures a maximum of I_R.

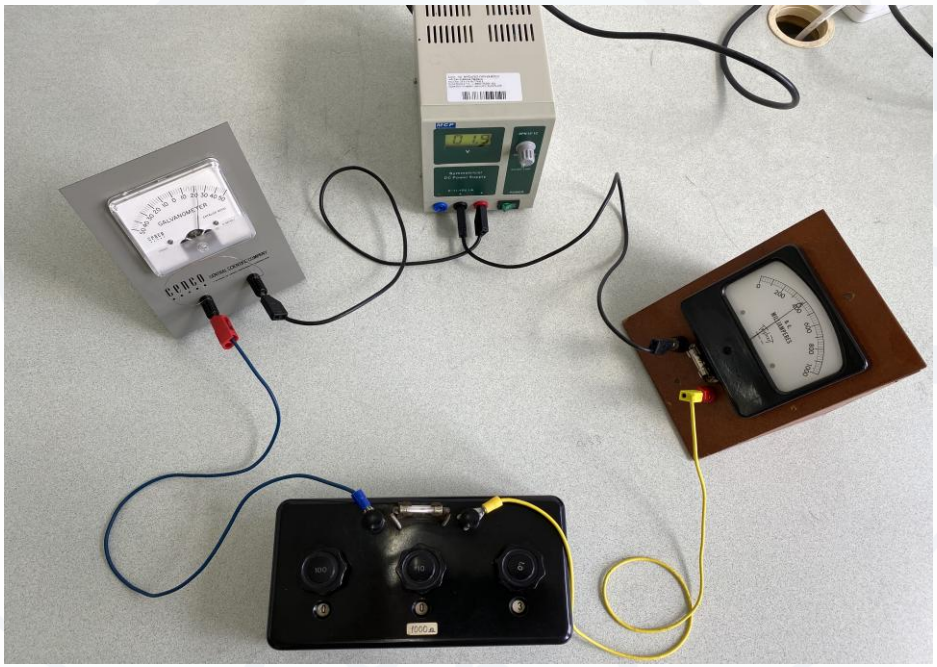
CONSTRUCTED AMMETER

CONSTRUCTION OF AN AMMETER

Now, we will test our constructed ammeter using a power supply and a 2-3 Ω resistance.

Use 500mA scale and connection of Real ammeter. Do not use 50mA!

Draw the circuit diagram of the test curcuit for the constructed ammeter.



EXAMPLE TEST CIRCUIT FOR AMMETER
(devices may differ in the Lab)

PART 1: AMMETERS

CONSTRUCTION OF AN AMMETER

Calculate the ampere value of the constructed ammeter Remember FSD gives you range current, then the deflection on Galvanometer when the test circuit is connected will give you the ampere value of the constructed ammeter.

Then calculate the percentage error.

Q-5) Construct an ammeter by cutting L+2.0 cm of copper wire and connect it to the galvanometer in the correct way. Test the constructed ammeter in the test circuit, setting R_{box} to 2 or 3 ohms. Use 500mA scale of the real ammeter.

a) Value read from the **Galvanometer**: (0.2 p) $G_X =$

b) Calculate the corresponding current value read from the **Constructed Ammeter**: (1 p)

$I_{CA} =$

c) Value read from a **Real Ammeter**, note the set R_{box} value (0.6 p)

$I_{RA} =$ $R_{box} =$

d) Calculate the percentage error for I (1 p) (Accuracy matters in this part!)

% Error for $I =$

READ LAB WEBSITE FOR THE EXAM RULES!

DO NOT FORGET TO BRING A SCIENTIFIC CALCULATOR AND a printed copy of THE APPLIED EXAM SHEET (as BLANK!)