



## PW N°0: Introduction to equipment and reminders

### 1. Principale and objectives :

This introductory session will allow students to familiarise themselves with the equipment they will be using during these practical electricity experiments, including ammeters, voltmeters, various resistors, connection boxes, oscilloscopes, transformers, etc.

They will also learn to:

- Recognise the various components of an electrical circuit.
- Correctly measure electrical voltage and current in a circuit.
- Use a digital multimeter: its functions (voltmeter, ammeter, ohmmeter, capacitance meter, etc.), precautions to take, estimation of measurement error.
- Experimentally verify Ohm's law and Kirchhoff's laws: node law and mesh law.
- Build an electrical circuit based on a diagram.
- Visualise voltage on an oscilloscope.

### 2. Theoretical reminder

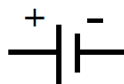
#### 2.1. Components of an electrical circuit:

##### a) Voltage generators :

These are electrical devices that can deliver alternating (symbol  $\sim$ ) and/or direct (symbol  $=$ ). Voltage is measured in volts (V) in the International System of Units (SI).



(a)



$$E_1 = 9V$$

(b)



$$E_2 = 6V$$

(c)

Figure 1: Symbols for voltage sources in electrical circuits

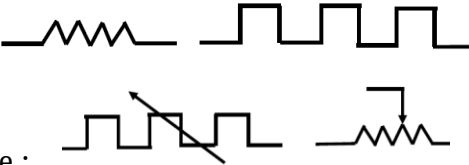
**There are two types of power source:**

- **Fixed voltage power sources**, which deliver 1, 2 or 3 fixed voltages; in this case, there are 1, 2 or 3 outputs. Some power sources have one voltage in continuous mode and another in alternating mode.

- **Variable power sources**, which have a control switch (potentiometer) for adjusting the desired voltage

### b) Resistors

An electrical resistor is an electrical dipole that reflects the property of opposing the passage of an electric current. In other words, in a circuit, a resistor has the effect of reducing the intensity of the electric current. This reduction is greater when the resistance value is higher. Resistance is often denoted by the letter  $R$ , and its unit of measurement is the ohm (symbol:  $\Omega$ ). They are either fixed value or continuously variable (rheostat).

- symbol for a fixed resistance: 
- symbol for a variable resistance :

### c) capacitors

A **capacitor** is an electrical component that stores energy in the form of an electric field between two conductive plates separated by an insulating material (dielectric). Its ability to store charge is measured by its **capacitance**  $C$ , expressed in **farads** (F).

### d) Appareils de mesures

- **Ammeter**

An ammeter is a device used to measure the intensity of an electric current. It is always connected in series in an electrical circuit. For this reason, the measurement accuracy of an ammeter depends on its internal resistance; the lower the resistance, the more accurate it is. The ammeter can be set to direct current (DC) mode (=) or alternating current (AC). The unit of measurement for electric current is the ampere, denoted by A.

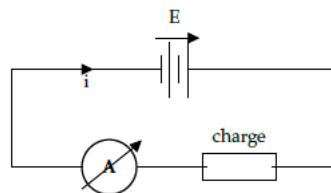


Figure 2: Connection of an ammeter

### e) Voltmeter

A voltmeter is a device used to measure the potential difference or voltage between two points in an electrical circuit. It is always connected in parallel in an electrical circuit. For

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this reason, unlike an ammeter, the greater the internal resistance of the voltmeter, the higher the measurement accuracy.

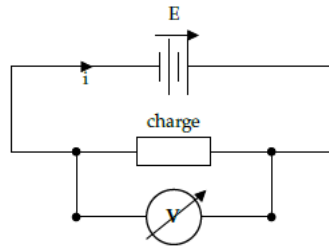


Figure 3: Connection of a voltmeter

### f) Ohmmeter

An ohmmeter is an instrument used to measure the electrical resistance of a component or electrical circuit. To use an ohmmeter, disconnect the load to be measured from the electrical circuit and place the ohmmeter across its terminals. The device, thanks to its internal battery, will circulate a very low current in the load and measure the voltage obtained to deduce the resistance. The unit of measurement for electrical load is the ohm.

### g) Multimeter

A multimeter is a measuring device. It combines several devices: a voltmeter, an ammeter and an ohmmeter. A multimeter can also incorporate other functions: measuring the capacity of a capacitor, measuring the frequency of an electrical signal, measuring voltage peaks, measuring the temperature on the circuit, testing a diode or continuity, etc.

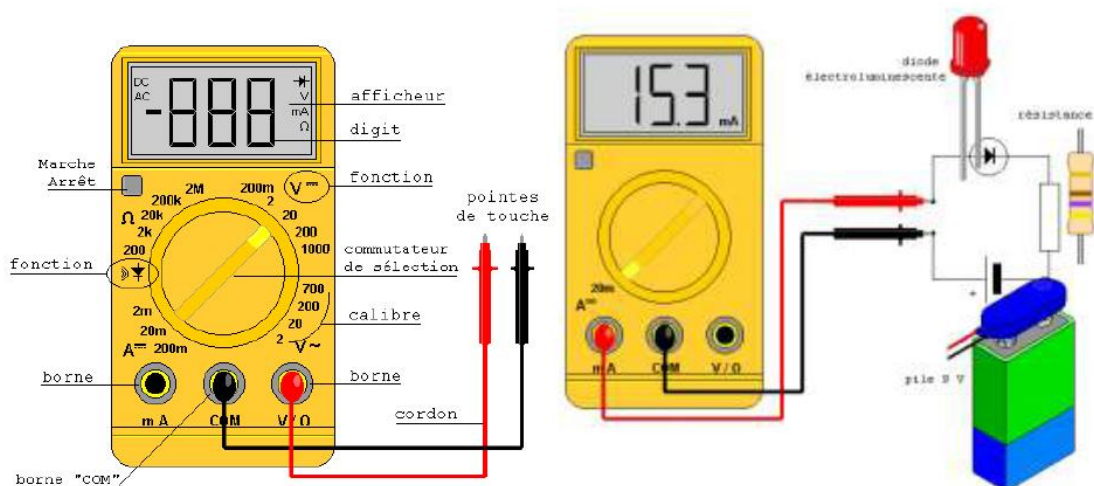


Figure 3: The different functions of a multimeter.

### ❖ Calibration

The calibration of an analogue ammeter, analogue voltmeter, analogue ohmmeter, or multimeter (digital) is the criterion used to take measurements in the same way, that is to say, to take a direct reading of a value (voltage, current or resistance) once the cursor (or knob) is set to a given value on the reading scale.

$$X = \frac{\text{caliber} * \text{indicated graduation}}{\text{Number of graduation (scal)}}$$

#### h) A function generator (GBF)

Is an electronic device that produces different types of electrical waveforms, such as sine, square, and triangular signals, over a wide range of frequencies. It is mainly used in laboratories to test and analyze the behavior of electrical and electronic circuits.



Figure 4 :Low-frequency generator

#### i) oscilloscope

An oscilloscope is an instrument used to visualise electrical signals, meaning that it allows you to see the shape of the signal and also read the values measured by the measuring instruments. The advantage of an oscilloscope is that it allows you to check for signal distortion or deformation, which other measuring devices cannot do.

### 3. Manipulation

Using the connection box, resistors R1 and R2, connection wires, switch and generator (on the workbench):

1. Assemble the circuit shown in Figure 5 below (have it checked by the practical teacher before applying power).
2. Set the voltage delivered by the generator to 6 V (check with the voltmeter).

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3. Measure the current flowing through  $R_1$  and  $R_2$ . For the ammeter, always start with the highest rating (to avoid burning it out), then decrease the rating to just above the measured current value.
4. Using the voltmeter, measure the voltage  $U$  across  $R_1$  (following the procedure from the highest rating to the appropriate rating for the measurement), then  $U$  across  $R_2$ .
5. Compare  $U+U$  to  $E$ .
6. Conclusion.

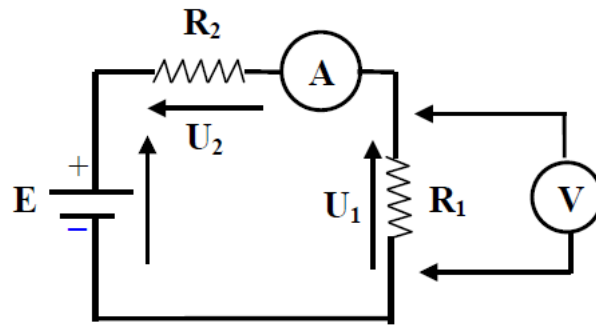


Figure 5: Measuring current and voltage using an ammeter and voltmeter