

Experimental Science

P3: Multimeters. Measurement errors.

1. Purpose

- Measure electric resistance, voltage and electric current intensities.
- Estimate analogue and digital maximum device errors.

2. Introduction

In what concerns the way they display their result, devices can be divided into analogue and digital. In an analogue device, the output is a continuous function of the device's input (as in a ruler or a mercury thermometer). In the case of a digital device the output takes a numerical form and varies discretely (as in a digital chronometer or an electronic scale).

3. Experimental activity

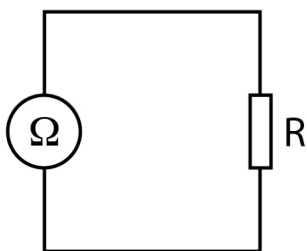
3.1 Material

1 multimeter, 1 voltage supply, several resistances of various nominal values, connecting wires, crocodiles.

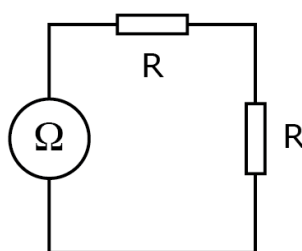
3.2 Procedure

3.2.1 Resistance

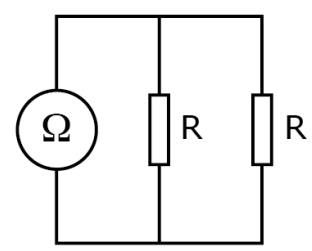
1. Measure with a multimeter (operating as an ohm meter) the value of the electrical resistance of each of the resistances (except for the repeated ones). In order to do so, assemble the circuit as depicted in circuit 1a. Use the most sensitive scale of the measurement device.



Circuito 1a



Circuito 1b

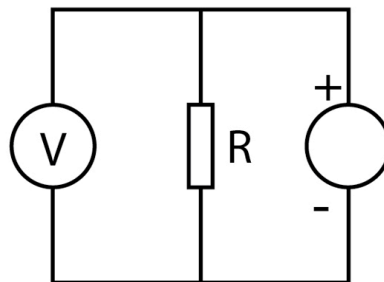


Circuito 1c

2. Assess the maximum device error at the used scales.
3. Compare the measured value with the nominal values (obtained from the provided colour code table).
4. Repeat the procedure for circuits 1b and 1c but using only the repeated resistance sets.

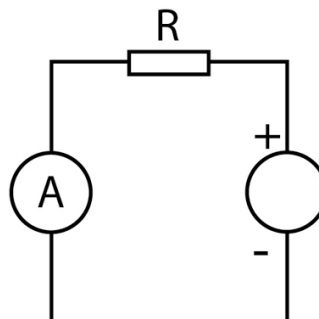
3.2.2 Voltage and current intensity

1. Check if all the voltage supply buttons are at the 0 V and 0 A positions.
2. Assemble circuit 2. Use a 1 k Ω resistance.



Circuito 2.

3. Before turning on the voltage supply, ask the teacher to confirm the circuit is properly assembled.
4. Set the voltage supply to 5 V.
5. Confirm the voltage with a multimeter.
6. In what function setting is the multimeter operating? Are the resistance and multimeter connected in series or in parallel?
7. Calculate the current intensity traversing the resistance.
8. Confirm the obtained value with a multimeter. Do so by turning off the voltage supply and assemble circuit 3.



Circuito 3.

9. Before connecting the voltage supply ask the teacher to confirm the circuit is properly assembled. **BEWARE:** if the multimeter is still connected in parallel with the voltage supply when it is turned on its fuse will be burnt.
10. Turn the voltage supply on and register your reading.
11. In what function setting is the multimeter operating?
12. Repeat the entire procedure for a different voltage and using a different multimeter. The applied voltage should be such that the current intensity traversing the resistance should not exceed 25 mA. What is the limit to the voltage you can apply to the resistance?
13. Compare the measured current intensity with the measured voltage to resistance ratio.