PHYSICS NYB

EXPERIMENT: Kirchhoff's Rules

Objective: To verify Kirchoff's rules:

Loop Rule: The sum of all potential differences encountered while going around any closed loop in a circuit is zero: $\sum_i V_i = 0$.

N.B. When going from (-) to the (+) terminal of an ***emf*** there is a positive difference of potential and when going through a resistor along the current direction there is a negative difference of potential. In the difference of potential (V_2-V_1), V_1 is the previous and is the last value V_2first following a selected direction of circulation in circuit.

Junction Rule: The sum of all currents flowing into or out a junction in a circuit is zero: $\sum_i I_i = 0$.

N.B. A current flowing into the junction is considered positive while the current flowing out of a circuit is considered negative.

Materials: Three resistors **R_1= 20 Ohm**, **R_2=30 Ohm**, **R_3=100** Ohm; two 6V sources, a voltmeter and an ammeter.

Procedures: Before building the electric schemas, measure and record the precise resistance values by using a multimeter.

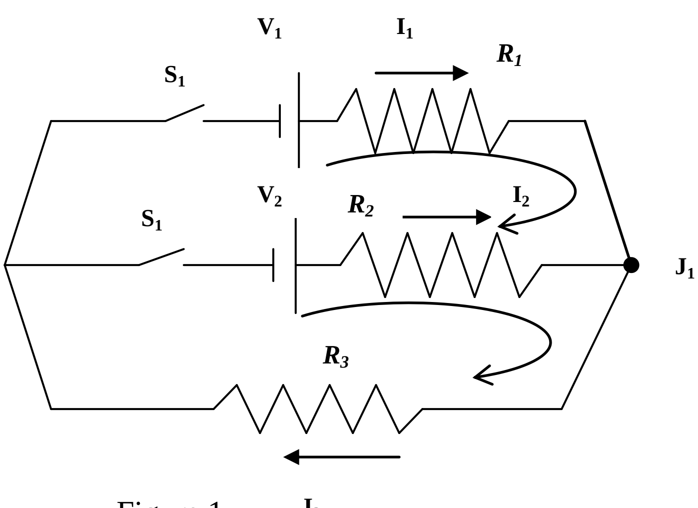

Figure 1

-Connect the circuit shown in figure 1
- Switch the switches S_1, S_2.
- **Measure** and record "quickly" the terminal voltage **V_1,V_2** of two sources using the voltmeter, and three current values **I_1, I_2** and **I_3** using the ammeter.
- As far as finished with these measurements, switch off S_1, S_2 to avoid the discharge of batteries.
- Use the measured values V_1,V_2, I_1, I_2 and I_3 in formulas (1,2,3) and verify if they transform them to identities . Use the uncertainty calculations to prove this.

After selecting the circulation direction as shown in the figure the Kirchoff's rules give:

Loop _1: $$V_1 - I_1 * R_1 + I_2 * R_2 - V_2 = 0 \rightarrow\rightarrow R_1 * I_1 - R_2 * I_2 = V_1 - V_2 \qquad (1)$$

Loop _2: $$V_2 - I_2 * R_2 - I_3 * R_3 = 0 \rightarrow\rightarrow R_2 * I_2 + R_3 * I_3 = V_2 \qquad (2)$$

Junction _J₁: $$I_1 + I_2 - I_3 = 0 \rightarrow\rightarrow I_1 + I_2 = I_3 \qquad (3)$$

Next, build the scheme presented in figure 2 by inverting the poles of battery 2. Write three equations (1', 2', 3') derived from the Kirchoff's rules for the scheme in figure 2. Measure and record V_1,V_2, I_1, I_2 and I_3. Repeat the procedure of verifications the same way you did for the scheme in figure 1.

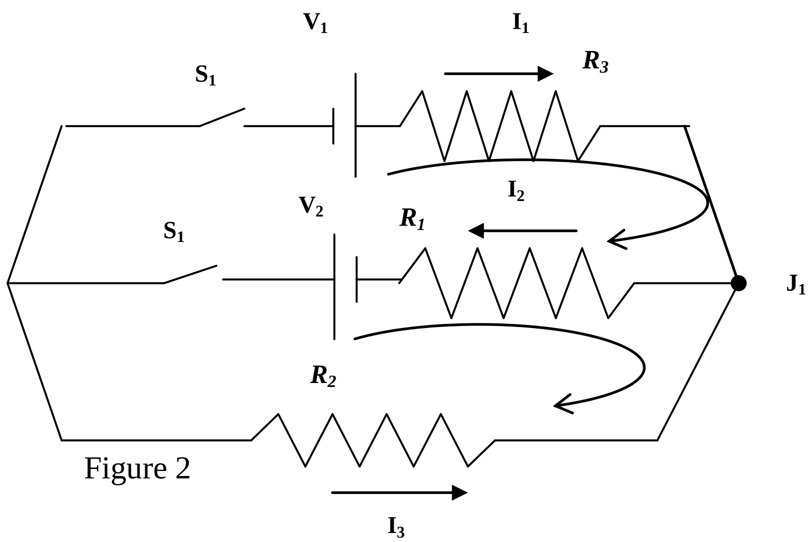

Figure 2

Calculations

- Put the measured values for terminal voltages V_1, V_2, and resistors' values R_1,R_2, R_3, in the equation (1', 2', 3') derived from Kirchoff's rules for the scheme in figure 2.
-Calculate the three current values I_{1t}, I_{2t} and I_{3t} from these equations.
- Compare the calculated values with the measured values I_1, I_2 and I_3.

Conclusions:

1- Do your measured data satisfy the Kirchoff's rules at junction J_1 and around the two loops for the scheme in figure 1?
2- Do your theoretical calculations based on Kirchoff's rules fit with measured values for currents corresponding to the scheme in figure 2?