(DC1-8) Kirchhoff's Loop Rule

Aim of experiment

Verification of Kirchhoff's circuit laws.

Apparatus

D.C Power Supply – Resistors – Wires – Ammeters – Voltmeters.

Theory of experiment

Simple current circuits can be analyzed using the expression V = IR and the rules for series and parallel combinations of resistors. Very often, however, it is not possible to reduce a circuit to a single loop. The procedure for analyzing more complex circuits is greatly simplified if we use two principles called Kirchhoff 's rules:

First rule: At any junction the sum of currents leaving the junction equals the sum of currents entering the junction.

$$\Sigma I_{in} = \Sigma I_{out} \qquad (1)$$

This *Junction rule*, which is also known as *Kirchhoff's first rule*, is simply a statement of the conservation of charge. For example, at junction b in *figure 1*, equating the currents entering and leaving the junction, we obtain

$$i_1 + i_2 = i_3 \qquad (1)$$

Second rule: The sum of the potential differences across all elements around any closed circuit loop must be zero:

$\Sigma \Delta V = 0$ for any closed loop

For example, if we traverse the right loop of *figure 1* in a counterclockwise direction starting and ending at point b, the loop rule, of Kirchhoff's, and according to sign convention rule, gives for the right loop;

$$\varepsilon_1 + i_3R_3 + i_1R_5 + I_3R_4 = 0 \qquad (2)$$

And for the left loop gives;

$$-\varepsilon_2 + i_2R_2 - i_1R_5 + I_2R_1 = 0 \qquad (3)$$

Equations (1), (2) and (3), are the three simultaneous equations needed to solve for the unknowns i_1, i_2, and i_3.

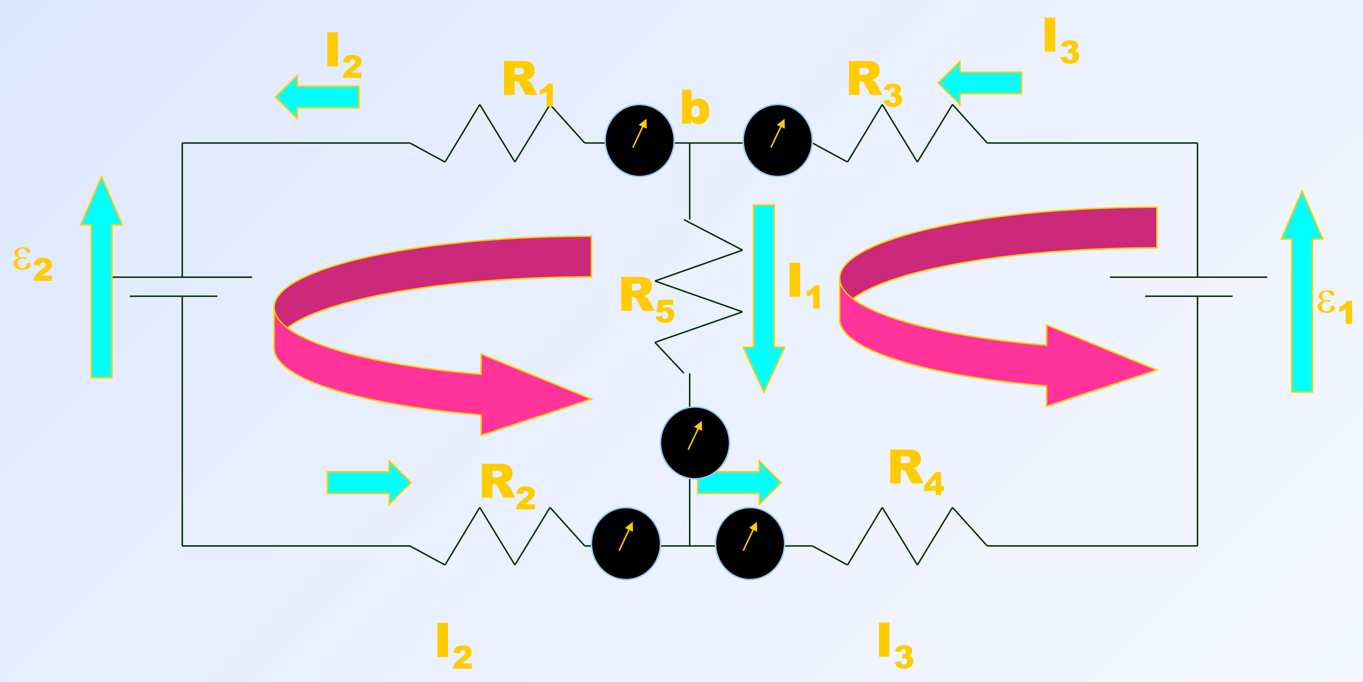

Figure 1 A multiloop circuit

Procedures

1. Connect the circuit as shown in *figure 1* and let both power supplies fixed at the value 9 volt.
2. Measure the currents in each branch, and verify the junction rule.
3. Measure the drop voltage across each resistance and verify the loop rule.
4. Repeat previous steps for power supplies combination of ε_1 and ε_2 at 9V, 6V and 6V, 9V respectively.
5. Draw the same circuit showing the current directions in each case.
6. Solve equations (1), (2) and (3), mathematically and compare to the measured values and directions of currents.

Results

	i_1 (A)	i_2 (A)	i_3 (A)	V_{R1} (volt)	V_{R2} (volt)	V_{R2} (volt)	V_{R3} (volt)	V_{R5} (volt)	Vε1 (volt)	Vε2 (volt)
9,9 (volt)										
6,3 (volt)										
3,6 (volt)										