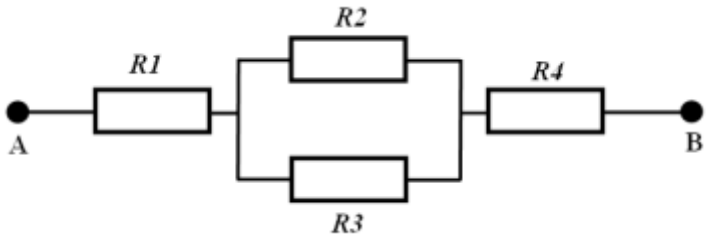
Faculty of Science and Technology
Department of Technology - L1 ST-SM-ENG
Exercise Series of GW of Physics 2, 2023-2024
Exercise Series Number 3 : Electrical Networks

Exercise N° 01

Consider the resistor circuit shown in the figure below.

We give: $R_1 = R_4 = 10\Omega, R_2 = R_3 = 8\Omega$.



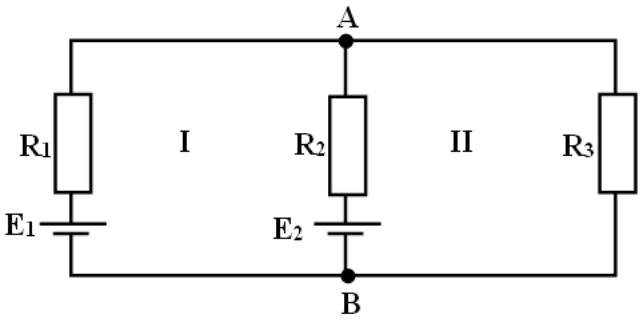
1. Calculate the total equivalent resistance R_{eq} of the entire circuit
2. A potential difference $\Delta V = 24\ Volts$ is applied to terminals A and B of the circuit. Using Ohm's law, calculate the current I_{eq} flowing through the total equivalent resistor R_{eq}
3. Deduct the current flowing through each resistor in the circuit.
4. Deduct the applied potential difference between the terminals of each resistor in the circuit.

Exercise N° 02

Let be the circuit in the figure below. We give: $R_1 = 2\Omega,\ R_2 = 5\Omega, R_3 = 10\ \Omega, E_1 = 20\ V$ and $E_2 = 70\ V$.

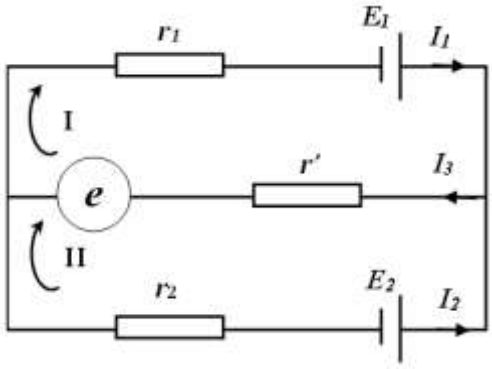
1- Applying KIRCHHOOF*'s laws*, write the equations corresponding to nodes A and B and loops I and II.

2- Calculate the currents flowing through the three branches of the circuit, specifying the actual direction of the currents.



Exercise N° 03

We consider the circuit in the figure below having a generator of E.m.f $E_1 = 100V$ and a reversible generator of E.m.f $E_2 = 50V$, of respective internal resistors $r_1 = 1k\Omega$, $r_2 = 2k\Omega$ and an C.e. m.f "e" and internal resistance receptor $r' = 100\Omega$.



1.Establish the expressions for the intensities of the currents$I_1, I_2\ et\ I_3$ flowing in the different branches of the circuit.

2. What condition must the C.e. m.f "e" of the receiver be verified in order for the device to function?

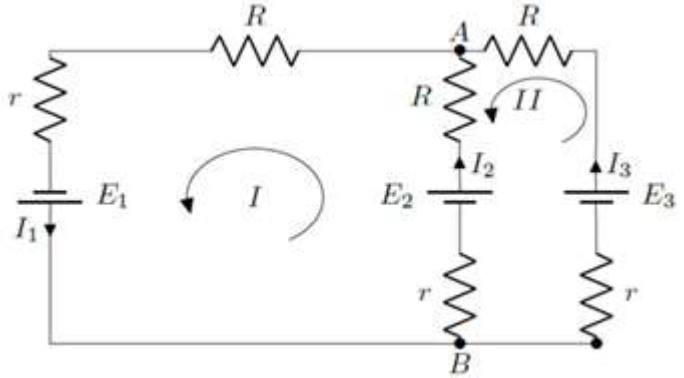
3. Calculate $I_1, I_2\ and\ I_3$ for $e = 60V$.

4. Does the element of the E.m.f "$E2$" function as a generator or as a receiver? Justify your answer.

Exercise N° 04

The electrical circuit in the figure below is composed of reversible generators of internal resistors r such as $E_1 = 6V, E_2 = 3V, E_3 = 2V, R = 3\Omega, and\ r = 1\Omega$.

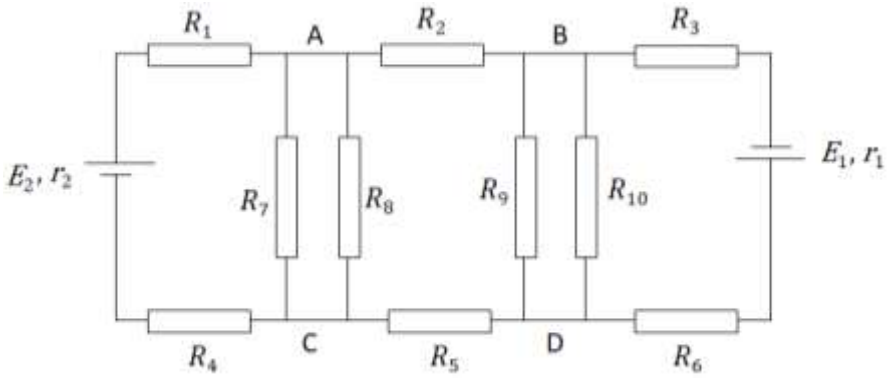
1. Applying KIRCHHOFF's laws, write the equations corresponding to nodes A and B and meshes *I* and *II*. Then give the system of equations that allows us to calculate the electric currents passing through the different branches of the circuit.
2. Solve the previous system by determining the values of the electric currents $I_1, I_2\ and\ I_3$.



Exercise N° 05:

Let be the circuit in the figure below. We give: R_1 = 20Ω, R_2 = R_3 = 25,R_4 = 10Ω, R_5 = R_6 = 50Ω, R_7 = R_8 = 100Ω, R_9 = 1000Ω, R_{10} = 25Ω, E_1 = 9V, E_2 = 12V, r_1 = r_2 = 1Ω.

Calculate the currents flowing through the generators $E_1\ and\ E_2$.



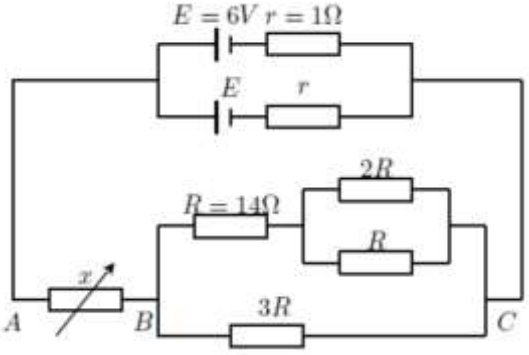
Exercice N° 06

The circuit below (left) has two identical generators of E.m.f "E" and internal resistance r, a variable resistor *x* and an assembly of resistances between B and C.

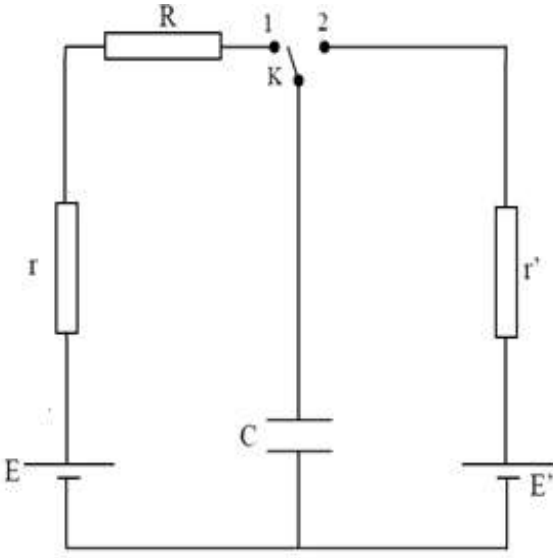
1. Finding Resistance R_{BC} equivalent to the portion (BC) of the circuit.
2. Express the magnitude of the current flowing through the resistor x as a function of E, r, x and R_{BC}.

a) Finding the Power Dissipated in the Resistance x.

b) For what value of resistance x is this power maximum?



Exercice N° 07



I. At time $t = 0s$ we put the switch K in position 1

a. What is the differential equation giving the d.d.p VC across the capacitor.

b. What is the time constant τ of the circuit?

c. Give the expression of V_C as a function of time.

d. Calculate V_C for $t = 0, \tau, 2\tau, 3\tau, 4\tau\ and\ 5\tau$.

e. Represent the allure of tension $V_C(t)$.

II. In fact, at time $t_1 = 2\tau$, we put the switch K in position 2.

a. What is the differential equation giving the d.d.p V_C across the capacitor?

b. What is the new time constant τ' of the circuit?

c. Give the expression of V_C as a function of time.

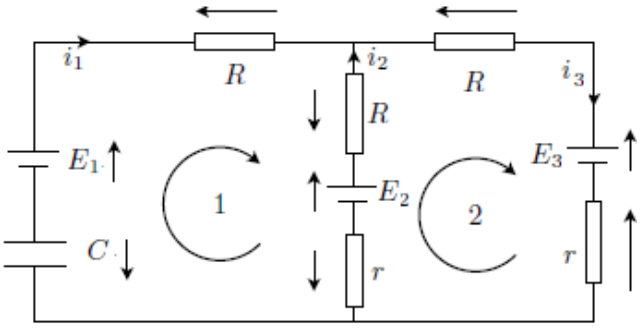
d. Calculate V_C for $(t\text{-}\, t_1) = 0, \tau', 2\tau', 3\tau', 4\tau'\ and\ 5\ \tau'$.

e. Plot the change in VC over time on the same graph as in (1-e).

f. Which way does the current flow?

Exercise N° 08

Find the capacitor charge in the figure below where the currents are represented on the connecting wires and the voltages by the separate arrows. Initially, the capacitor was discharged.$q(t)$



Exercise N° 09

Let be the circuit in the figure below, consisting of a real generator:(E, r) of a resistor R and a capacitor of capacitance C. We give, *E* = 5 V, *r* = 50 Ω, *R* = 5 kΩ and *C* = 1µF.

Knowing that at $t = 0s$, the capacitor was completely discharged:

1°/ Write the differential equation that governs the capacitor charge. From this, deduce the expression of $q(t)$.

2°/At what time can we say that the capacitor has fully charged?

3°/Calculate the currents flowing through this circuit in steady state (en régime permanent).