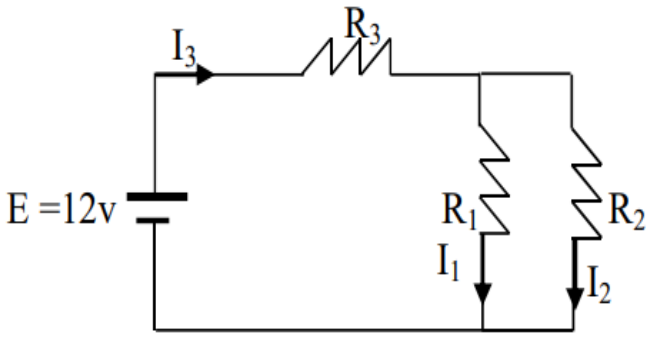
Mohamed Khider University of Biskra **Academic Year 2025–2026**
Faculty of Medicine
1st Year Medicine

Series 4
Bioelectricity: Membrane Potential (Nernst Equation)
Equilibrium Donnan

Exercise 1 :
Calculate the currents I_1, I_2, and I_3.

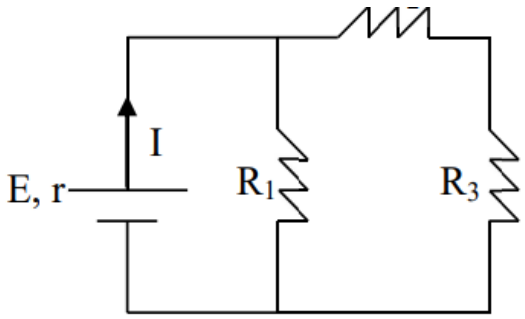


Numerical data:
R_3 = 820 Ω , R_1 = 330 Ω and R_2 = 220 Ω

Exercise 2:

A battery with electromotive force (emf) E =1 0^5 V and internal resistance r = 0.5 Ω supplies the circuit shown opposite.

The resistances R_1, R_2, and R_3 have respective values of 20 Ω,, 5Ω and 15 Ω.



Questions

a- Calculate the equivalent resistance of the entire circuit.
b- Calculate the current delivered by the battery.
c- Calculate the potential difference (voltage) across the terminals of the battery.

Exercise 3:

A cell membrane is permeable only to potassium ions K^+.The temperature is 37°C.
Potassium concentrations are:

- Inside the cell: [K+]in = 140 mM
- Outside the cell: [K^+]out = 5 mM[

Questions

a- Calculate the equilibrium (Nernst) potential for K^+
b- Interpret the sign of the result.
c- Explain the physiological meaning of this potential.

Exercise 4:

Two parallel plates with surface area S = 25 cm^2, separated by 5 cm, are vertically immersed in a solution containing K^+ ions.
A potential difference of 20 V applied across the plates produces an electric current of 0.1 A.

a- Calculate the concentration of K^+ ions in this solution.
$\mu_{K+} = 7.6\times10^{-8}\ m^2s^{-1}$, F = 96500

Exercise 5:

We have a car battery with an electromotive force (EMF) E = 12 V and an internal resistance r = 10 Mω.
A copper wire with resistivity ρ = 1.7×10^{-8} Ω.m, length 50 cm, and cross-sectional area 1 mm^2 is connected across the battery terminals.

Questions

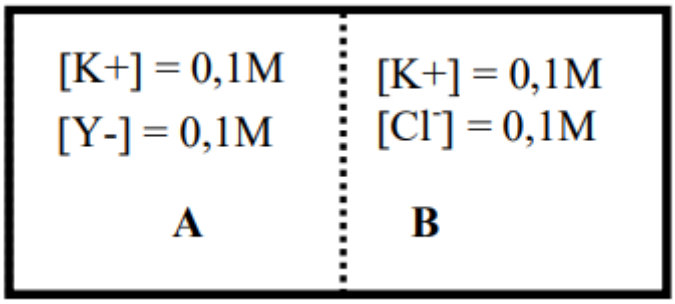
a- Calculate the resistance R of the wire.
b- Calculate the current flowing through the wire.
c- Calculate the thermal power dissipated by the wire.

Exercise 6:

We consider two compartments, A and B, of constant volume, separated by a membrane that is permeable to K^+ and Cl^- ions but impermeable to Y^- ions. The ionic concentrations are as follows:

Compartment A:
[K+]A=[Y−]A=0.1 M

Compartment B:
[K+]B=[Cl−]B=0.1 M



Questions

a) In what sense is the membrane separating A and B a Donnan membrane? What does the Gibbs–Donnan equation describe?

b) Are the ions at equilibrium?

c) At equilibrium, what will be the concentrations of the different ions in each compartment? What will be the potential difference between A and B?

B.BOUDOUR