

MEMBRANE POTENTIAL MEASUREMENT AT NERNST EQUILIBRIUM

The aim of the practical

The aim of the practical is to investigate the electrodiffusion and Nernst equilibrium in the system consisting of ion solutions and ion-selective membrane. Students perform the measurements of the voltage that exist on cation-selective membrane at equilibrium.

Equipment and solutions

1. Multimeter
2. Measuring chambers separated by a cation-selective membrane
3. Silver/silver-chloride (Ag/AgCl) electrodes — 2 pcs.
4. Three NaCl solutions: 0,01 mol/dm³; 0,001 mol/dm³; 1 mol/dm³.

Procedure

1. Using a graduated cylinder, measure out 85 ml of **0,01 M NaCl** solution and fill the left (**L**) chamber of the measuring setup with it (this is concentration c_1). Fill the right (**R**) chamber with 85 ml of **0,001 M NaCl** solution (this is concentration c_2).
2. Slowly raise the electrode holder and remove the plastic protective covers (test tubes) from the electrodes.
3. Rinse the electrodes with distilled water from a wash bottle and dry them with a paper tissue.
4. Slowly immerse the electrodes into the solutions through the openings in the chambers by lowering the holder. Make sure the electrodes do not touch the bottom of the chambers.
5. Connect the electrodes to the multimeter sockets — COM (left electrode) and V/ Ω (right electrode); make sure the meter is **switched off** before connecting.
6. Switch on the meter and read the potential-difference value (mV).
7. Read the potential difference off the multimeter.
Important: wait until the reading stabilizes (i.e., remains stable for at least 30 sec). Enter the stabile value into the table.
8. Switch off the meter, slowly lift the electrodes, rinse them with distilled water (avoid letting water enter the chambers) and dry them.
9. Fit a tip from box **1** onto pipette **1** and set the appropriate volume using the upper knob.
10. Using the pipette, add 100 μ l of **1 M NaCl** solution to the right (**R**) chamber and mix the solution with a glass rod. Do not change the concentration in the left (**L**) chamber.

11. Slowly immerse the electrodes into the solutions through the openings in the chambers. Make sure the electrodes do not touch the bottom of the chambers.
12. Switch on the meter and read the potential-difference value (mV) as in step 7.
13. Perform successive measurements by repeating steps 8–12. Before each measurement, add **1 M NaCl** solution to the right chamber (P). Add **100 µl of 1 M NaCl** to each of the first five measurements, and add **200 µl of 1 M NaCl** to each of the next four measurements. Remember to mix the solution after each concentration change.
14. After finishing the all the measurements, switch off the meter and disconnect the electrodes.
15. Rinse the electrodes with distilled water.
16. Slowly raise the electrode holder, put the plastic covers back on the electrodes (the tubes may be filled with distilled water) and then slowly lower the holder.
17. Discard the solutions from the chambers, rinse the chambers several times with distilled water, and finally fill them with distilled water.
18. Calculate the NaCl concentration values in the right chamber using the formula:

$$c_2 = \frac{c_0 V_0 + c_d V_d}{V_0 + V_d}$$

where: c_0 — initial concentration of the solution in the right chamber;

c_d — concentration of the added solution;

V_0 — initial volume of the solution in the right chamber;

V_d — total volume of 1 M NaCl added so far to the right chamber (cumulative volume of all added solution).

19. On the plotting paper, plot the dependence of the potential difference on the logarithm of the concentration ratio: $\Delta V = f(\log c_1/c_2)$.

Required theoretical knowledge:

1. Passive membrane transport – electrodiffusion.
2. Nernst equilibrium.
3. Nernst equilibrium potential.
4. Membrane voltages in living cells.
5. Goldman equation.

Wroclaw Medical University Department of Biophysics and Neuroscience	Practical No 8 Membrane potential measurement at Nernst equilibrium	
..... Names of students		Faculty: Group No: Date:
Grade:	Tutorial signature	

1. Perform the measurements and complete the table.

No.	Concentration c_2 [mol/dm ³]	Concentration ratio c_1/c_2	Log (c_1/c_2)	Measured voltage ΔV [mV]
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

2. On the plotting paper, plot $\Delta V = f(\log c_1/c_2)$.