1.a. Verification of Nernst`s equation for Ce^{+3}/Ce^{+4} redox system

REDOX ELECTRODE. The main part of the redox electrode is platinum platelet. The potential of electrode occurs if immersed in the solution with reduction oxidation system (for example mixture of Ce^{+3} and Ce^{+4} cations). The established redox potential is controlled by the Nernst`s equation:

$$E_{Redox} = E^0_{Ce^{+3}/Ce^{+4}} - \frac{RT}{nF} ln \frac{a_{Ce^{+3}}}{a_{Ce^{+4}}} \cong E^0_{Ce^{+3}/Ce^{+4}} - 0{,}059\, log \frac{[Ce^{+3}]}{[Ce^{+4}]} \qquad (1.1.)$$

where $E^0_{Ce^{+3}/Ce^{+4}}$ is standard redox potential of the Ce^{+3}/Ce^{+4} system, R is Gas constant, F is Faraday`s constant, n is the number of transmitted electrons, a_{M^+} and $[M^+]$ are activities and molarities of Ce^{+3} or Ce^{+3} cation respectively. The value 0.059 in equation (1.1) is the Nernst's electrode response in Volts at $T = 298K$ (compare response for ISE).

The redox potential is measured by a combined redox electrode that contains the redox electrode and the reference electrode in one unit. The eqn $E_{Redox} = EMV + E_{ref}$ is valid, where E_{ref} is constant potential of reference electrode and EMV is the electro motoric voltage (EMV) of the combined electrode.

TASK: Verify the Nernst`s equation for the $Ce^{+3}/Ce^{+4}$ system. Evaluate the experimental Nernst`s response of the redox electrode and compare it with a theoretical value of $59\, mV$. Determine the $[Ce^{+3}]/[Ce^{+4}]$ ratio in the unknown samples (e.g., in the Belousov-Zhabotinsky oscillating system).

LABORATORY AIDS AND CHEMICALS: combined Pt-redox electrode, potentiometer, electromagnetic stirrer, *2* beakers *(100 cm^3)*, *3* scale glass pipettes (*25, 10 a 5 cm^3), 10* volumetric flasks *(50 cm^3)*, storage solution for redox electrode (*$5 \cdot 10^{-2}$M KCl* or saturated *KCl.* Stock solutions: *0.006M $Ce(SO_4)_2$* in *1.5 M H_2SO_4*, *0.006M $Ce_2(SO_4)_3$* in *1.5 M H_2SO_4*.

INSTRUCTIONS: Get acquainted with the use of the potentiometer in mode mV reading.

MEASUREMENT OF EMV FOR STANDARD SOLUTIONS. Pipette the *50ml* of the *0.006M Ce^{3+}* stock solution into beaker. Add the *0.006M Ce^{4+}* stock solution in volume *0.5 ml* and measure the electro motoric voltage (EMV) using combined redox electrode after stabilisation. Into the same solution, pipette gradually the *0.006M Ce^{4+}* stock solution in volumes of 2.0, 2.5, 20 and 25 ml. Measure the EMV after each addition.

MEASUREMENT OF UNKNOWN SOLUTION. Measure the EMV of combined redox electrode of the system with unknown $[Ce^{+3}]/[Ce^{+4}]$ ratio. Alternatively, record the EMV in the Belousov-Zhabotinsky oscillating system.

REPORT: TABLE 1: for *0.006M Ce^{3+}* stock solution and all other prepared standard solutions: volume of *0.006M Ce^{4+}* adition, total volume, concentrations of Ce^{+3} and Ce^{+3}, value $\log([Ce^{+3}]/[Ce^{+4}])$, experimental EMV. **Graph 1:** Dependence of $EMV = E_{Redox} - E_{ref}$ on value $\log([Ce^{+3}]/[Ce^{+4}])$. **NEXT:** experimental Nernst`s response, $[Ce^{+3}]/[Ce^{+4}]$ ratio of unknown sample. Alternatively, the $[Ce^{+3}]/[Ce^{+4}]$ ratios at minimum and maximum of the EMV in the Belousov-Zhabotinsky oscillating system.