Unless otherwise noted, assume that:

T=25°C

R= 1.99 cal mol^-1 deg^-1

Faraday’s Constant= 23,062 cal volt^-1 equiv ^-1

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Please explain with the maximum amount of details as possible!! Thank you!!

Problem:

During an experiment a neuropsychologist measures the membrane potential of a squid giant axon in the presence of a bathing solution of known composition. He then removes the cytoplasm and replaces it with a synthetic solution. At the same time he alters the external medium from that used before and again measures the membrane potential. From the above info and the info given below calculate the following values…

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | First measurement outside | Inside  (control) | Second measurement outside | Inside (experimental) |
| K⁺ | 20mM | ? | 150mM | 15mM |
| Na⁺ | 180 | ? | 20 | 200 |
| Membrane  potential | -42.5 mVolts | | +18.06 mVolts | |

Cl⁻ distributes itself across the cell membrane according to the membrane potential. All other anions are impermeable.

1. What is the permeability ratio for the movement of Na⁺ compared to the movement of K⁺ at rest (Pna/Pk)?
2. What is the equilibrium potential of Na⁺ under the conditions of the second measurement?
3. What is the equilibrium potential of K⁺ under the conditions of the second measurement?
4. What is the Cl⁻ outside/ Cl⁻ inside ratio under the conditions of the second measurement?
5. Assuming that K⁺i= 10 x Na⁺ i, what is the concentration of Na⁺ inside the axon during the initial (control) measurements?
6. With the same assumptions as in (e) above, what is the concentration of K⁺ inside the axon during the initial (control) measurements?