Problem Set 2

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Derivation of the Goldman-Hodgkin-Katz formula for membrane potential

The reversal potential we discussed in the class only take into account one type of ion. However, some channels are not quite selective, and we need to combine the current flow from multiple ions, and the result is the Goldman-Hodgkin-Katz formula for membrane potential. I will write down the equation here, and it is your homework to provide the derivation of this formula.

$$V_m = \frac{k_B T}{e} \ln \left(\frac{\sum_{i=1}^{N} P_{M_i^+}[M_i^+]_{out} + \sum_{j=1}^{N} P_{A_j^-}[A_j^-]_{in}}{\sum_{i=1}^{N} P_{M_i^+}[M_i^+]_{in} + \sum_{j=1}^{N} P_{A_j^-}[A_j^-]_{out}} \right). \tag{1}$$

Here P denotes the permeability of a given ion.

Note: The first and the second problem sets are due on **Sep 18, 2024**.