MCB166 — Fall 2017— Final Exam

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Monday 11$^{\text{th}}$ December, 2017

1. **Membrane potentials in a retinal rod**

Consider a membrane permeable to Na^+, K^+, and Cl^- with relative permeabilities, P_{Na}, P_K, and P_{Cl}. Assume the ions all obey the constant-field current voltage curve

$$I_x = FP_xZ_xv\left([X]_o - [X]_i\exp(v)\right)/(1-\exp(v)).$$

Here $v = eV/kT = V/25\text{mV}$, X is the concentration of species x in mM, F is the Faraday constant, and Z_x is the valence of species x.

We want to compare current-voltage relations and reversal potentials for two different ion channels. One is the typical imperfectly-selective potassium channel (K-ch), for which $\alpha_K = P_K/P_{Na} = 50$. The other is a cation channel (Cat-ch), such as is found in postsynaptic and sensory-receptor membranes, for which $\alpha_U = P_K/P_{Na} = 1$.

For a vertebrate photoreceptor, the internal and external ion concentrations are:

$$[K]_o = 5\text{mM};\ [Na]_o = 120\text{mM};$$
$$[K]_i = 125\text{mM};\ [Na]_i = 12\text{mM}.$$

(a) ok.

ok.

(b) ok.

ok.

(c) ok.

ok.

(d) ok.

ok.

(e) ok.

ok.

2. Ok.

   (a) ok.

   ok.

   (b) ok.

   ok.

   (c) ok.

   ok.

3. Ok.
   (a) ok.

       ok.
   (b) ok.

       ok.
   (c) ok.

       ok.

4. Ok.

   (a) ok.

   ok.

   (b) ok.

   ok.

   (c) ok.

   ok.

   (d) ok.

   ok.

5. Ok.
   (a) ok.

       ok.
   (b) ok.

       ok.
   (c) ok.

       ok.
   (d) ok.

       ok.

6. Ok.

   (a) ok.

   ok.

   (b) ok.

   ok.

   (c) ok.

   ok.

   (d) ok.

   ok.

   (e) ok.

   ok.