Math 430 and Math 635: Analytical and Computational Neuroscience
Fall 2001. Prof. V. Booth
Homework 3. Due: Wednesday, Oct. 3, 2001

1. From the formulas for $\alpha_m(V)$ and $\beta_m(V)$, determine formulas for $m_\infty(V)$ and $\tau_m(V)$. Also find formulas for $h_\infty(V)$, $\tau_h(V)$, $n_\infty(V)$ and $\tau_h(V)$.

2. Plot all the steady state activation/inactivation functions $m_\infty(V)$, $h_\infty(V)$ and $n_\infty(V)$, and all the time constant functions $\tau_m(V)$, $\tau_h(V)$ and $\tau_n(V)$.

3. Suppose the following voltage clamp "experiment" was performed using the Hodgkin-Huxley model: Initially, the voltage is at the rest potential at approximately -65 mV and then the voltage is stepped up to -25 mV and held there.

   (a) What is the steady state value of the K^+ current (where steady state means as $t \to \infty$)?

   (b) What is the steady state value of the Na^+ current?

   (c) Making the approximation that the activation gating variable m for the Na^+ current changes instantaneously as compared to the inactivation gating variable h, what is the maximum possible peak value for the Na^+ current?

4. Repeat Problem #3 if the voltage is stepped from the rest potential up to 0 mV and held there.