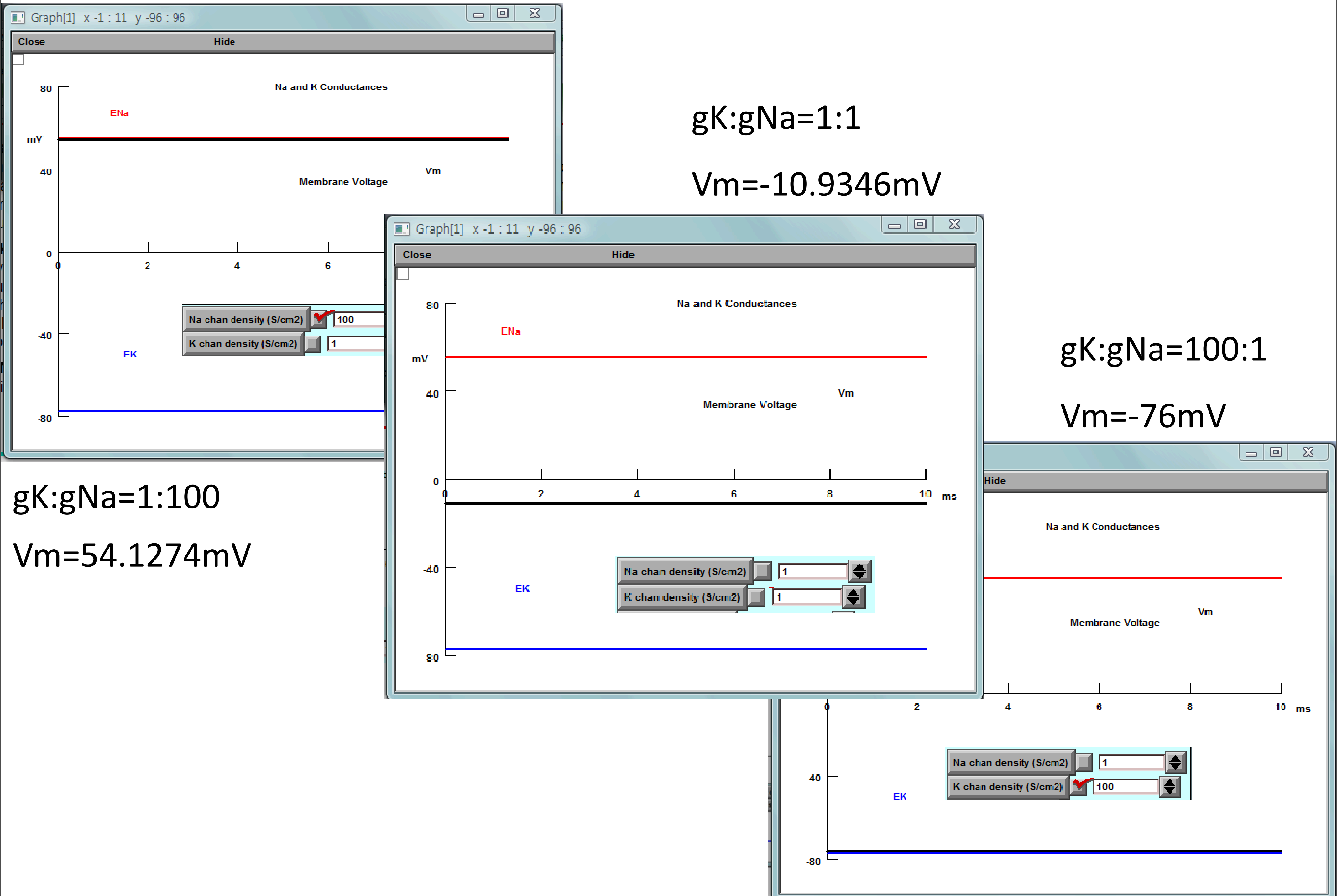
Lab F Completed

With Bonus

Signals involve changing conductance ratios



gK:gNa=1:1

Vm=-10.9346mV

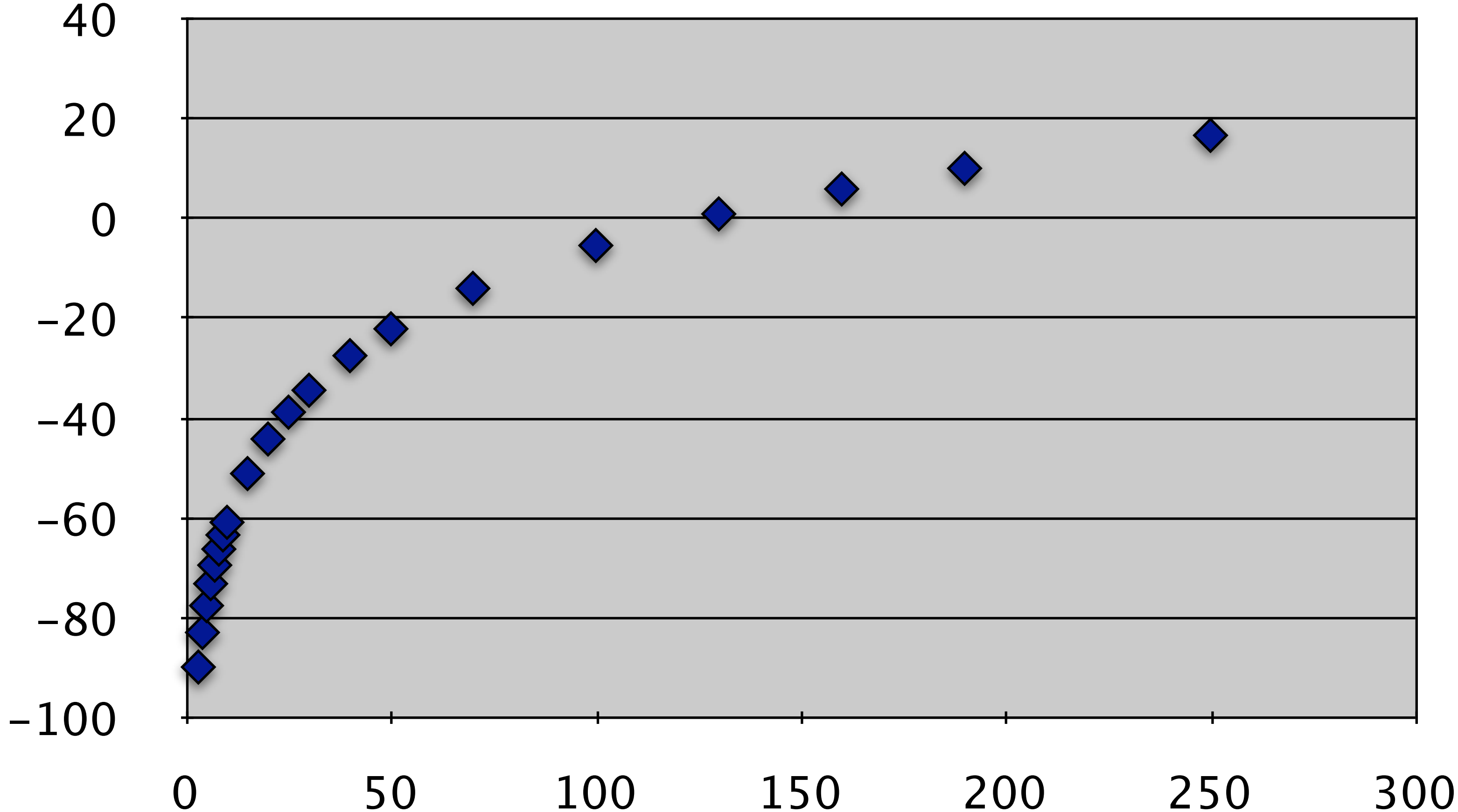
gK:gNa=100:1

Vm=-76mV

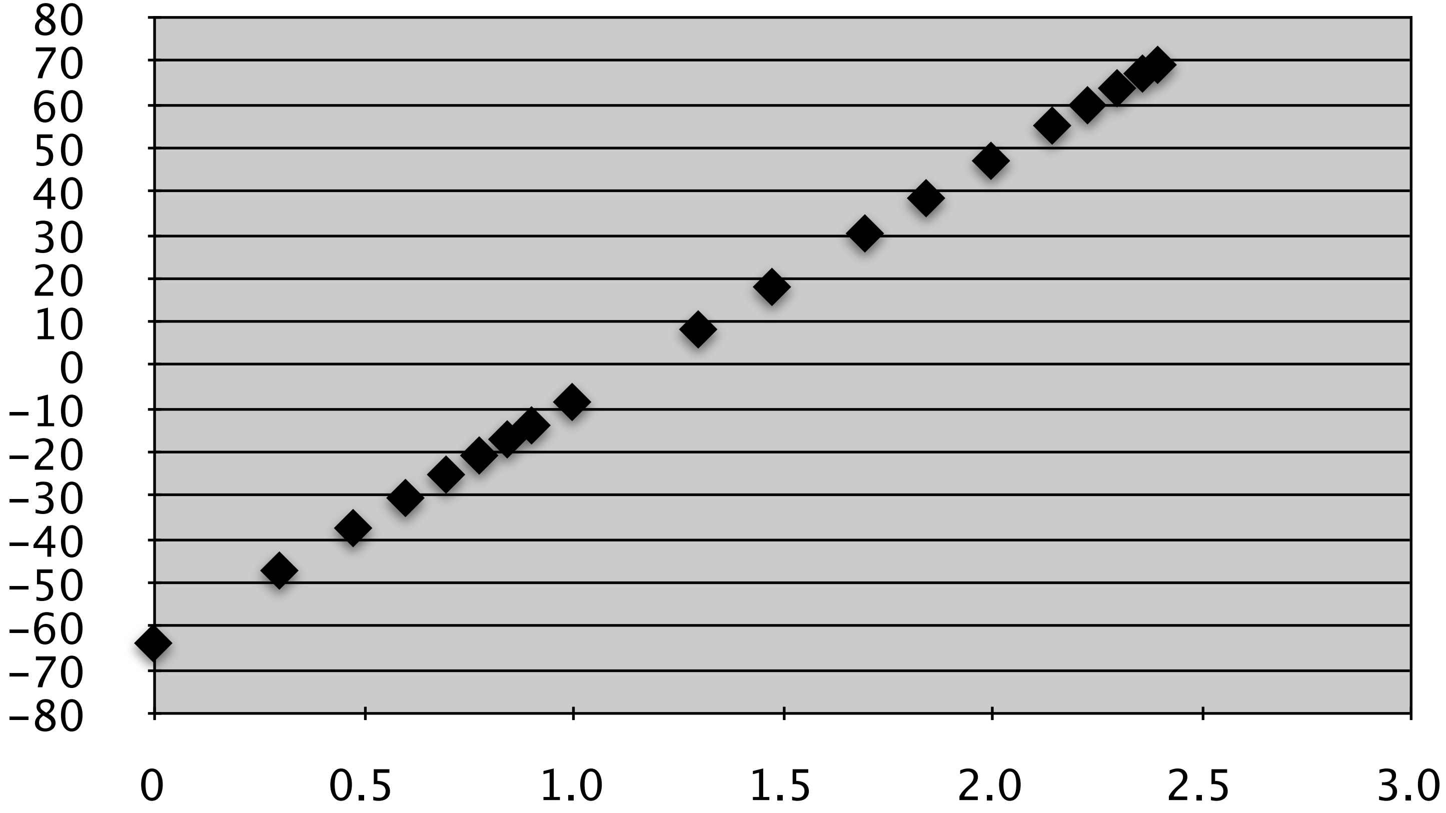
gK:gNa=1:100

Vm=54.1274mV

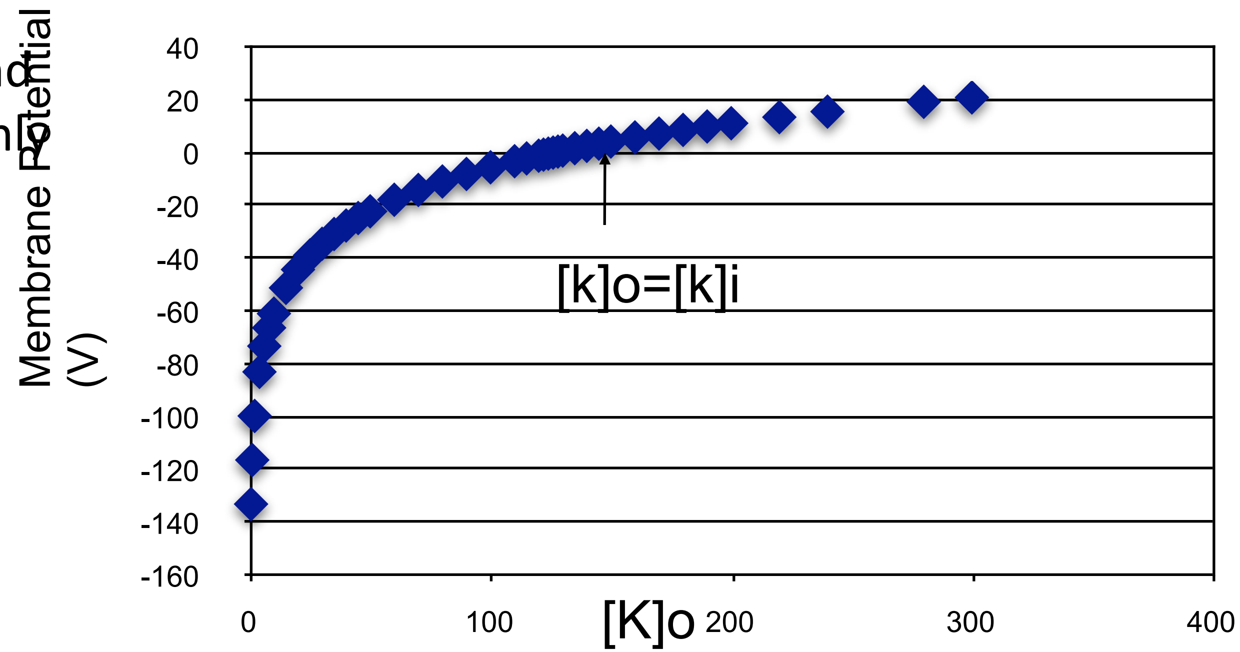
Plot E K versus [K]o.



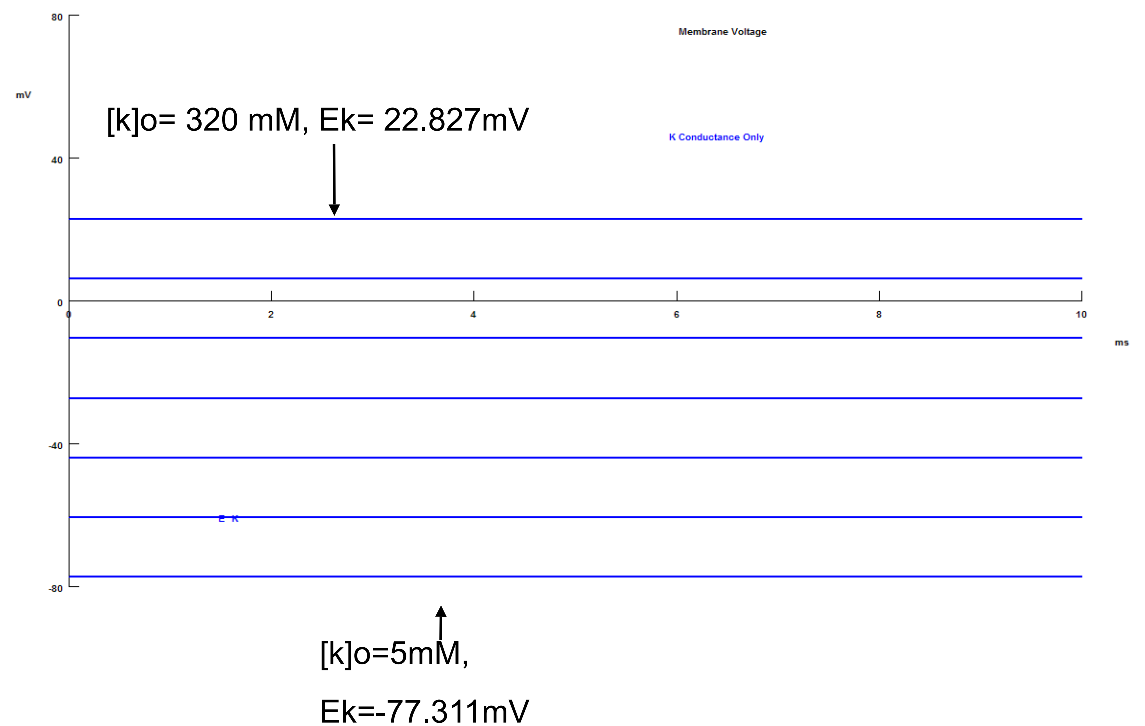
E Na versus log [Na]o



Observation 2 – the relationship between [k]o and [k]i when the membrane is only permeable to K+ ions

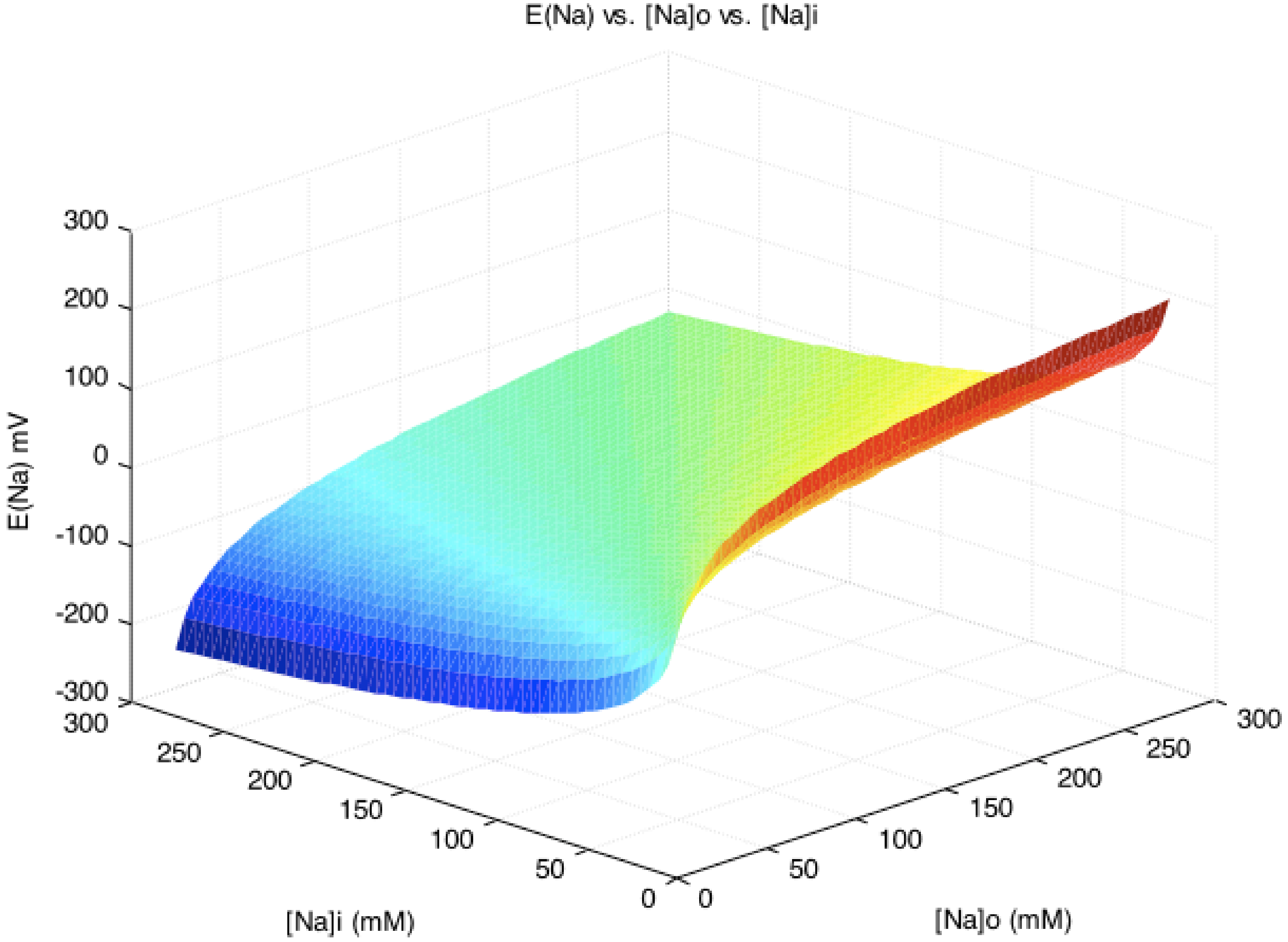


With an intracellular concentration of 124mM, the logarithmic relationship between the extracellular and intracellular potassium levels is apparent.



Consequently progressively doubled concentrations of [k]o (starting from 5mM) produce increases of about 16.93mV.

Changing [Na]o and [Na]i



Bonus Problem

The hypothesis was that changing concentration of K had more effect because the conductance of K was higher?

To test this further, I will change the conductance ratio to 1:50 (K, Na) and change the concentrations of each ions.

Bonus

Treat V_m as a random variable which is a function of three other random variables:

E_K E_{Na} E_L with standard deviations of $\sigma_K \sigma_{Na} \sigma_L$. If you write the resting membrane potential

as: $V_m = \dfrac{G_L X_L + G_{Na} X_{Na} + G_K X_K}{G_L + G_{Na} + G_K}$ *and then take the variance*:

$$Var(V_m) = \frac{1}{(G_L + G_{Na} + G_K)^2}\left(G_L^2 \sigma_L + G_{Na}^2 \sigma_{Na} + G_K^2 \sigma_K\right)$$

Now we try to minimize the variance of V_m with the restriction that the individual conductances must add to the maximum membrane conductance:

$$G_L + G_{Na} + G_K = 156.3$$

Using the method of Lagrange multipliers, the Lagrange equations are:

$$G_L + G_{Na} + G_K - 156.3 = 0$$

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To take the partials in G_L, G_{Na}, G_K, of the Var(V) equation, then solve the resulting Lagrange system would take a long time. But it would be interesting to see if the actual conductances are the ones that minimize the variance with the above restriction, or to find the actual restriction to which the conductances yield minimal variance of the membrane voltage.