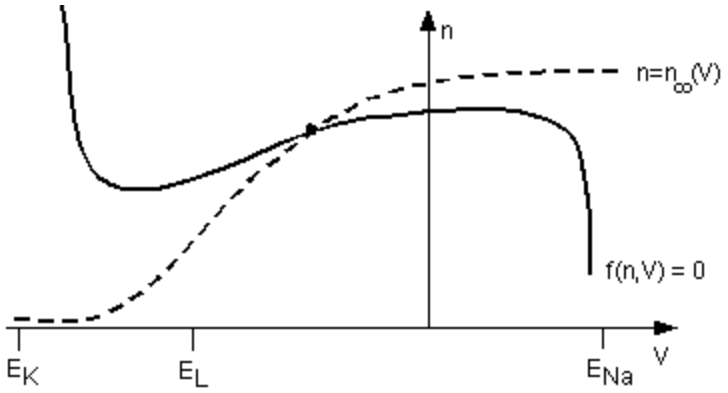
Homework Math 6390
Due February 17, 2000

Use the (n,V) phase plane to discuss the following phenomenon. (Draw pictures.)

1) Relative Refractory Period – Following an action potential, a second stimulus is given during the recovery phase (between point 4 and the return to point 0 in the diagrams in class). What can you say about (i) the threshold voltage that must be reached to achieve an action potential, (ii) the size of the voltage step requires to reach threshold, (iii) the peak voltage achieved during the action potential, and (iv) the duration of the action potential.
2) Spontaneous Oscillations – Suppose the slow manifold is shifted so that it intersects the curve $n=n_\infty(V)$ somewhere on the unstable (T) branch of the slow manifold. Then the (n,V) phase plane looks like this:



What happens?
3) Anode-break Excitation – (using the un-shifted manifold) From $t=\infty$ until $t=0$, the transmembrane potential is clamped at some value v* which is sufficiently negative that

$$n_\infty(v^*) < n_1$$

(Recall that n_1 is the smallest value of n reached by the R branch of the slow manifold.)

At t=0, the voltage clamp is removed. What happens?

Would the result be any different if a membrane at rest were suddenly stepped to the voltage v*? Explain the difference between these two situations. (Hint: think about n.)