York University BPHS 3090 (Winter 2015) - HW 6

Due Date: Mar. 30, 2015 9:30 AM

Questions

1. Weiss v.2 Exercise 2.6 (pg.72), but modified slightly such that the axon diameter is 20 μm. Make sure to clearly explain how you arrive at your answer. Also, what would happen if the recording electrode was instead placed 13 mm away, but on the side of the axon from the stimulation site?

2. The following two experiments are performed on a squid giant axon:

- *Experiment #1:* The axon is placed in a large volume of sea water, and the size of the *transmembrane* action potential is measured by means of an intracellular micropipette and is found to have a peak-to-peak value of 100 mV. The conduction velocity is 34 m/s.
- *Experiment #2:* The axon is placed in oil and the transmembrane potential is still found to 100 mV peak-to-peak. The peak-to-peak size of the *extracellular* action potential is 65 mV.

Estimate the expected conduction velocity in Experiment # 2. State your assumptions.

3. Weiss v.2 Problem 2.9 (pg.83), but modified slightly such that the axon diameter is 200 μm.

4. In a first year physics course, one learns that an electrical network is an interconnection of electrical elements within a given circuit consisting of a closed loop to allow for a return path for the current. In other words, the current has a return path such that the charge can 'flow' throughout the circuit. Consider Weiss v.2 Fig.3.8. Does this system represent a 'circuit'? If so, sketch what the circuit looks like (and clearly label the key variables). If not, explain why.

5. Below you will find data from the paper *Phase Locking to High Frequencies in the Auditory Nerve and Cochlear Nucleus Magnocellularis of the Barn Owl, Tyto alba* [Koppl, C. (1997), J. Neurophysiol.].

a) Explain what *vector strength* is and how it relates to the notion of *phase locking*. Make sure to briefly explain how one would quantify phase locking.

b) Describe the overall trend in the data above. What might be the physiological basis for such?

Some references to consider are Joris, P. (2006). "A dogged pursuit of coincidence" (J Neuro) and a lecture on hearing from Stanford at the following url `http://www-psych.stanford.edu/~lera/psych115s/notes/lecture12/`

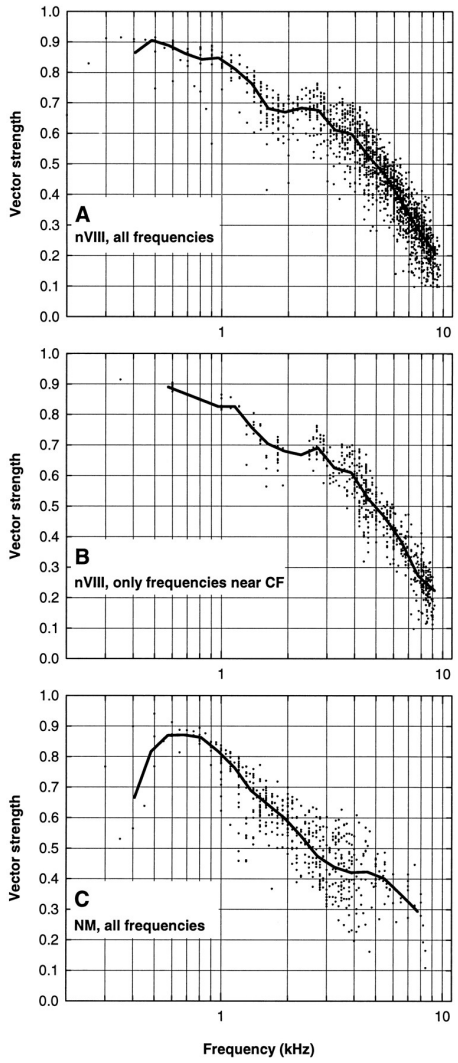

Figure 1: The data show the vector strength of the Nucleus Magnocellularis neuron (auditory relay neurons) to different frequencies

6. Weiss v.2 Exercise 3.5 (pg.139), but in addition to answering simply true/false, justify your answers graphically.

Extra Credit – Weiss v.2 Problem 3.6 (pg.143).