7.29 J 9.09
Cellular Neurobiology
Midterm Test
19 March, 2003

Answer **Question 1** and **four of the five others**. Each answer is worth 20 points. If you answer all six questions the first five will be graded.

No books, no notes, no cooperation permitted. Calculators are allowed.

All lettered subsections of a question have equal point value unless otherwise specified.

All questions have specific answers. It is to your advantage to be brief.
You may use telegraphic rather than grammatical English if you wish, so long as your reasoning is made clear.

Question 1.
Identify the following terms and indicate how they relate to the course: (2 points each)

a) M Channel
b) Xenopus
c) Yeast mutants
d) Freeze Fracture
e) Saltatory
f) Cyclic AMP dependent kinase
g) Schaeffer Collateral
h) Tetraethylammonium
i) Vagusstoff
j) Atropine

Question 2.
a) Hodgkin and Huxley did a simple experiment to show that the squid axon membrane was predominantly conductive to sodium ions at the top of the action potential (maximum overshoot). What did they do? (4 points)

b) At the point of maximum overshoot, V_m=50 mV; E_{Na}=55 mV, E_K=-80 mV. What is the conductance ratio g_K/g_{Na}? (10 points)

c) What approximating assumption did you make in calculating answer (b)? (2 pts)

d) What is the capacitative current at the point of maximum overshoot? (4 points)

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Question 3.

a) Write the expression for the space constant, λ of an axon. (2 points)
b) A metal wire has, for our purposes, zero resistance (infinite conductance). How could you arrange one or more wires to **maximize** the space constant, λ? How does the maximization work? (8 points)
c)What would the altered space constant be (approximately)? (4 points)
d) What would the conduction velocity of the axon be (approximately)? (2 points)
e) Has a similar experimental setup been described in this course? What was it used to do? (4 points)

Question 4.

In a particular synapse of a particular neuron, Gaba (gamma-amino butyric acid) binds to a receptor which is a ligand-gated chloride ion channel. The reversal potential for chloride E_{Cl} is –75 mV, the same as the resting potential for this cell.
a) Is this synapse inhibitory, excitatory, or neither? Why? (5 points)
b) How would you detect the presence of this synapse? (5 points)
c) How would you measure the total number of chloride channels at this synapse using only electrophysiological methods? (10 points)

Question 5.

In another synapse of another neuron, serotonin binds to a G-protein-coupled receptor which activates an unknown second-messenger system which in turn **closes** a chloride ion channel. Again, the equilibrium potential for chloride E_{Cl} is –75 mV, the same as the resting potential for this cell.
a) Is this synapse excitatory, inhibitory, or neither? Why? (5 points)
b) How would you detect the presence of this synapse? (5 points)
c) Does this synapse have a reversal potential? If so, how is it different from the reversal potential of the synapse in question 4 above? (10 points)

Question 6

We Have encountered one example of **occlusion** in class.
a) Describe the preparation. (4 points)
b) How was occlusion observed? Be specific about how the experiment was done or how you would do the experiment. (6 points)
c.) What did the experimenters conclude? (3 points)

d) How could you reach a similar conclusion using the patch-clamp technique? (7 pts)

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