

## 7.29 Midterm

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) Luteinizing hormone releasing hormone (LHRH)
- b) Xenopus
- c) Morris water maze
- d) Donald O. Hebb
- e) Neostigmine
- f) Calmodulin
- g) Oligonucleotides containing the CRE sequence (...TGACGTCA...)
- h) Bacterial toxin (one example)
- i) Vagusstoff
- j) Beta-propranolol

### Question 2.

Describe the NMDA receptor. Identify:

- a) its natural agonist (1 point)
- b) a specific agonist (1 point)
- c) a specific antagonist (1 point)
- d) The ion or ions it conducts (1 point)
- e) necessary conditions for its efficient ion conductance. Explain how these arise. (3 points)
- f) the location of the molecule (anatomical locus, cellular locus) **in the system described in the lectures** [the molecule is generally very widely distributed] (3 points)
- g) Its role in synaptic transmission there. (4 points)
- h) Its putative role in the animal's behavior. What two lines of experimental evidence argue for such a role? (6 points)

[PAGE OVER]

**Question 3.**

The triangle thingummy below is the symbol for an electronic device that is an essential component of a voltage clamp used by Hodgkin and Huxley.



- (a) What are the inputs? Where do they come from? (5 points)
- (b) What is the output? Where does it go to? (3 points)
- (c) How are the inputs and the output related? (4 points)
- (d) How is the output of the device related to the properties of the axon? (5 points)
- (e) What would happen if you switched the input leads, one for the other? (3 points)

**Question 4.**

Indicate the experimental evidence that synaptic transmission, and in particular vesicle fusion, occurs too rapidly for enzymatic reactions to be involved.

- (a) Identify the experimental organism and synapse. (3 points)
- (b) Describe the experimental setup. (2 points)
- (c) Describe the experimental procedure and the specific trick involved to obtain the high time resolution. (7 points)
- (d) Describe the experimental result – best done with two graphical traces on one co-ordinate system. Indicate the specific measurement that leads to the conclusion at the top of the question. (8 points)

[NEXT PAGE]

**Question 5.**

The first potassium channel gene was cloned from a *Drosophila* mutant called *shaker* (the fly shook under ether anesthesia). Studies on the neuromuscular junction indicated that the mutant muscle shows higher than normal depolarization following stimulation of the presynaptic nerve. The voltage profile (shape) of muscle action potentials is not altered in the mutant

- (a) How would you determine whether the increased synaptic transmission arose from presynaptic or postsynaptic changes? What change would you expect to observe in each case? (8 points)
  
- (b) How would you rationalize a mutated (inactive) potassium channel leading to greater synaptic transmission? Would you expect the salient change to be in the presynaptic or the postsynaptic cell? (8 points)
  
- (c) What analogous situation have we discussed in the class lectures? (4 points)

**Question 6,** On synapses onto the Oblate Cells in the ferret infundibulum, the amino acid neurotransmitter GABA (gamma-amino butyric acid) induces hyperpolarization below resting potential, as does the peptide Vasopressin. You can insert one or more intracellular electrodes into the Oblate Cell, but you cannot patch clamp because of connective tissue problems.

- a) How would you obtain persuasive evidence that the two neurotransmitters act to open or close the same class of channel? (8 points)
  
- b) How could you determine whether the transmitters open or close an ion channel? (8 points)
  
- c) Suppose the transmitters act to open an ion channel. What is your best guess as to the ion or ions conducted? (4 points)

**END OF EXAM**

MIT OpenCourseWare  
<http://ocw.mit.edu>

7.29J / 9.09J Cellular Neurobiology  
Spring 2012

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.