QUIZ 04 - KEY

Instructions: Download the quiz from Blackboard (in Quiz Questions Folder), print a copy and use the paper copy to work through the various questions and problems. Mark the correct answers on it. When you are ready to **submit** your answers, you will see the quiz posted under Quiz Answer Sheets.

Click the quiz name to launch the quiz. Enter your answers to each of the corresponding numbered questions onto the **blank answer sheet** (the questions will not be repeated, simply a blank page for your answers). The quiz may be saved if you do not finish entering your answers in one sitting. When you are finished with the quiz, make sure to **submit** your answers and they will be recorded.

For each question, select the one **best answer** from among those given (multiple choice). Each question is worth one (1) point.

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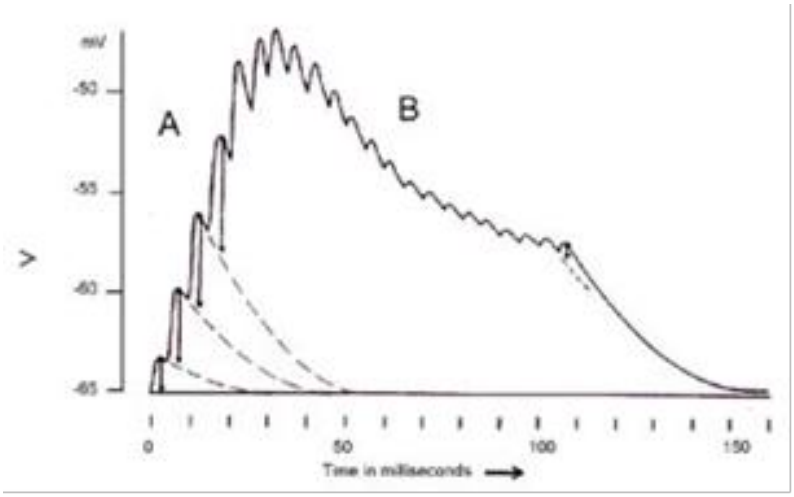
1. The temperature-sensitive shibere mutant of Drosophila blocks the activity of dynamin, a protein that is essential for vesicle endocytosis and recycling, when the temperature is raised. What do you expect to observe when the temperature is elevated and you begin to stimulate the presynaptic cell tonically?

   a) No effect on synaptic strength at the first stimulation.
   b) Increase in the surface area of the pre-synaptic terminal with time.
   c) Loss of synaptic facilitation with time.
   d) Loss of synaptic vesicles with time.
   e) All of the above.

Answer Key: This mutant will only affect the reuptake of neurotransmitters. Thus there should be no effect on synaptic strength at the first stimulation. However, as the transmitters cannot be recycled via endocytosis, transmitter will be depleted sooner at the presynaptic cell. So synaptic facilitation will be lost. The membrane used for vesicle-making cannot be recycled either, so the synaptic vesicles will be lost, and the surface area of presynaptic terminal will be larger.

2. You repeatedly stimulate action potentials in a single axon that innervates a neuron and find that the EPSP it evokes shows the interesting changes in amplitude during the stimulus train shown in the figure below. What is happening at the points marked by phase A and B? Choose the most likely answer.



a) A: temporal summation, B: desensitization
b) A: temporal summation, B: inhibition
c) A: facilitation, B: temporal summation
d) A: facilitation, B: depression
e) A: temporal summation, B: inhibition.

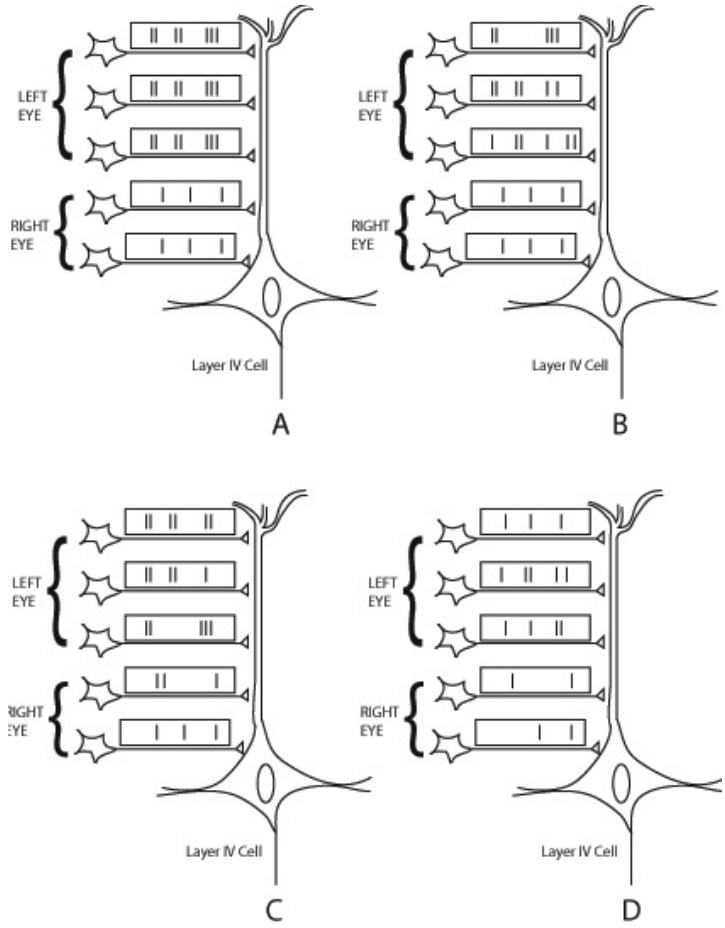
Answer key: For A the amplitude of each single spike is different, which is not consistent with summation but is consistent with it being facilitation. If A must be facilitation, only depression is also possible for B.

3. You are studying the expression pattern of a newly discovered frog gene during early development. Which of the following observations would lead you to believe that the expression of a particular gene is induced by an **extrinsic** signal?

   a) The gene is expressed primarily in the spinal cord.
   b) After a critical period the gene can no longer be expressed.
   c) Addition of an inducer signal to the water in which the eggs are floating causes excess expression of the gene in the embryo.
   d) The gene product is part of a second messenger system.
   e) All of these support the hypothesis that the gene expression is induced by an extrinsic signal.

Answe Key: A, B and D will not tell you if expression is triggered by intrinsic or extrinsic signals. C suggests that extrinsic signals are sufficient to induce the expression of the gene.

4. The following diagrams show inputs from the left and right eye onto a neuron in layer IV cell of the visual cortex. Based on the firing pattern of the afferents which of the layer IV neurons will most likely be part of the ocular dominance column for the LEFT eye?



Answer key: A is correct. Think about what makes the synapses between the inputs from the left eye and the target layer IV cell stronger.

5. You obtain a mouse mutant in which the growth cones cannot express the slit receptor protein. How many times would these growth cones cross the floor plate of the spinal cord?

   a) None. The growth cone will not enter the floor plate.
   b) Once.
   c) The growth cone will enter, but not leave the floor plate.
   d) Many times, since nothing is preventing the growth cone from being attracted to Netrin and slit.
   e) The growth will not form.

6. What will happen to NMDA receptors if they are immersed in Mg2+ free solution?

   a) They will be more likely to open when bind to glutamate
   b) They will become harder to open when bind to glutamate
   c) They will be more voltage-sensitive when bind to glutamate
   d) They will be less voltage-sensitive when bind to glutamate
   e) Nothing.

7. The "hebbian" learning rule states that synaptic weights between two neurons increase when the pre-synaptic and post-synaptic neurons are active at the same time. NMDA receptors on the postsynaptic neuron sense and respond to the simultaneous pre and post synaptic activity based **directly** on the simultaneous presence of …

   a) pre-synaptic and post-synaptic action potentials
   b) glutamate and release of the Mg2+ block
   c) pre-synaptic and post-synaptic depolarization
   d) none of the above

Answer key: Depolarization of pre-synaptic cell doesn't necessarily means the Glutamate will be released (as in case of depletion). Therefore A and C is not direct basis. Only B gives a direct basis.

8. NMDA receptor channels in the vertebrate brain differ from AMPA receptor channels in that only NMDA receptor channels:

   a) Are activated (opened) by glutamate.
   b) Allow K+ to leave the cell then they are open.
   c) Allow Na+ to enter the cell when they are open.
   d) Are normally blocked by Mg2+ ions.
   e) Allow Ca2+ to enter the cell when they are open.

9. Which of the following is **NOT** involved in patterning the developing nervous system?

   a) Concentration gradients of Netrin, Retinoic Acid and Fibroblast Growth Factor (FGF)
   b) NMDA receptors
   c) Patterns of neuronal activity
   d) Physical contact with other cells
   e) None of the choices is correct (all are involved in patterning).

10. A trillionaire gave you a huge amount of money to work on a project aiming at **restoring childlike plasticity to adult brains**. Your assistants came up with several potential research directions, as listed below. Which one of these potential research directions is most likely to success?
    a) Assistant A: We should promote neurogenesis by causing lesions in the brain!
    b) Assistant B: We should inhibit the expression of NMDA receptors in the brain to accelerate learning!
    c) Assistant C: We should increase the concentration of anterior neural tissue formation inducer in the body to make brain grow bigger!
    d) Assistant D: We should increase the expression of netrin receptors to help new axons find their way!
    e) All of them are wrong. Fire them all!

Answer key: Adult human brain only has a very small number of neural stem cells, so it's very unlikely that neurogenesis would be promoted by a lesion. Reducing the number of NMDA receptor will have complex effects on learning, but increasing overall plasticity is an unlikely outcome. Since the cells have already passed through early choice points, inducers will have no effects on them anymore. Developing axons have to express chemoattractant and chemorepellent receptors at the correct time to respond appropriately to local signals, so there is no reason to believe that expressing one particular receptor at a random time will lead to correct axon guidance.