MCB 160 - MIDTERM EXAM #1
MONDAY MARCH 3, 2008

Name ______________
ID#______________

Instructions:
-Only tests written in pen will be regarded
-Please submit a written request indicating where and why you deserve more points
-Original exams must be submitted with written requests
-Please submit regrade requests by end of class, Wednesday, March 19.
1. **[10 points]** An action potential (AP) triggers transmitter release from the presynaptic nerve terminal (bouton) and generates an EPSP. Release take place over a period of about 1 ms. What is the mechanism of AP-triggered release and why is it limited to such a short period of time?

2. **[10 points]** A second AP that arrives 100 ms after the first evokes a larger EPSP. Why is this so? Design an experiment that explains the role of calcium for this scenario.
3. [10 points] A single presynaptic AP evokes a fast EPSP. A burst of 20 APs at 50 Hz (pulses per second) evokes 20 fast EPSPs that start of very big and then get smaller and smaller. These fast EPSPs are followed by a delayed long lasting slow EPSP. Explain these observations and the role of the different receptors involved.

4. [15 points total] 10 inputs to a cell release excitatory transmitter within 5 ms of each other, but the cell does not fire. 100 inputs to the cell release excitatory transmitter within 5 ms and the cell fires an action potential.
   a) [5 points] Where in the cell is the action potential initiated? Why there?
b) [5 points] The action potential is conducted down to the nerve terminal. Why does it not “reflect” from there and get conducted back up the axon?

c) [5 points] Why do the inputs have to release transmitter so close to one another in time to fire the postsynaptic cell?
5. [10 points total]. During early development GABA receptors are excitatory, while later and in adult they become inhibitory! This is because there is a switch from one Cl- pump to another. What can this difference be? How does the GABA receptor select for Cl- ions and exclude Na+?

6. [20 points total] Axons from three presynaptic neurons synapse onto the same dendrite, close to the cell body (“near input”), far out on the dendrite (“far input”), and in the middle (“middle input”). The three have an equal probability of fusion of vesicles. “Far input” and “near input” release glutamate, while “middle input” releases GABA. Respond to following questions and explain your answers.

a. [10 points] Compare the size of the voltage response recorded in the postsynaptic cell body in response to a single action potential in the “near” versus the “far” glutamate input? Explain and illustrate.

b. [10 points] How will the size and shape (decay rate) of the postsynaptic voltage response differ if “far” and “middle” fire together? Draw the responses and explain your logic.
7. [15 points] Depolarization opens Na+ channels after a short delay. Soon after opening they stop conducting. What happens during the delay before opening? Why do they stop conducting even though the membrane is still depolarized and what sets the duration of opening before conductance stops? Support your explanation with an illustration of the channel. Label the relevant parts and explain how they work. Describe an experiment that demonstrates the mechanism that stops conduction after a short time.
8. [10 points] You mix together vesicles containing the one V-SNARE and a green dye with vesicles containing the two T-SNAREs and a red dye. What happens? Explain and name the various parts of the SNARE complex. How is this affected when you put on BOTOX, a protease that cleaves VAMP? How is it affected if you add Ca++ (in the absence of BOTOX)?