Simulating Synaptic Communication Name ________________

[All questions for this lab report are to be answered INDIVIDUALLY]

1. **What type of researcher would most likely do these types of experiments? (Ch 1, p 15)**
   a. Computational neuroscientist, b. Neurophysiologist, c. Psychophysicist,
   d. Neurochemist, e. Developmental neurobiologist

2. **On page 99 of your textbook, 3 different types of neurons are described. Which type seems to best match the integrate and fire neuron we simulated? Use saved figure.**
   a. A stellate cell, b. Most pyramidal cells, c. A particular type of large cortical pyramidal cells.

<u>The following set of questions relate to Activity 1:</u>

3. **What portion of the voltage time course did the capacitance, C, have the greatest effect on?**
   a. The buildup to threshold
   b. The maximum voltage of the spike
   c. The value of the voltage right after the spike

4. **How did the membrane leakage resistance, R, affect the input strength needed in order to reach threshold for spiking?**
   a. As R increased, the minimum level of I needed to reach threshold increased
   b. As R decreased, the minimum level of I needed to reach threshold increased
   c. The value of R had no influence on the minimum level of I needed to reach threshold

5. **How does the absolute refractory period, abs_ref, relate to the dynamic range?**
   a. As abs_ref increased, the dynamic range increased
   b. As abs_ref increased, the dynamic range decreased
   c. The value of abs_ref had no influence on the dynamic range

<u>The following set of questions relate to Activity 2:</u>

6. **According to the textbook on page 79, the maximum firing rate of a neuron is 1000 Hz. How does that compare to the observed firing rate in activity 2 of a simulated neuron characterized by a particular set of values (C=1, R=40, abs_ref=4)?**
   a. The observed max firing rate was much more (>1500 Hz)
   b. The observed max firing rate was a bit more (>1000 Hz, <1500 Hz)
   c. The observed max firing rate was a bit less (<1000 Hz, >500 Hz)
   d. The observed max firing rate was much less (<500 Hz)

7. **Based on your findings in activities 1 and 2, in order to simulate a neuron with a maximum firing rate close to 1000 Hz, in what range of values would the absolute refractory period need to be?**
   a. Less than 5 ms
   b. In between 5 ms and 15 ms
   c. Greater than 15 ms

<u>The following set of questions relate to Activity 3:</u>

8. **How does the membrane leakage resistance, R, relate to the time constant of temporal summation?**
   a. As R increases, the time constant decreases (the window of temporal summation shrinks)
   b. As R increases, the time constant increases (the window of temporal summation widens)
   c. The value of R has no influence on the time constant

9. **As the magnitude of the EPSP decreases, what happens to the window of temporal summation?**
    a. As the magnitude of the EPSP decreases, the time constant decreases (the window of temporal summation shrinks)
    b. As the magnitude of the EPSP decreases, the time constant increases (the window of temporal summation widens)
    c. The magnitude of the EPSP has no influence on the time constant

<u>The following set of questions relate to Activity 4:</u>

10. **In order to cancel out a strong EPSP, when did the IPSP need to occur?**
    a. Before the EPSP
    b. After the EPSP
    c. At the same time as the EPSP

11. **Why was the observed range of IPSP_start values wider for the weak EPSPs compared to the strong EPSPs in terms of canceling out the 1st spike?**
    a. Shunting inhibition has little to no effect on strong EPSPs, only on weak EPSPs.
    b. Shunting inhibition cancels out temporal summation, which was not necessary for strong EPSPs, only for weak EPSPs, in order to result in a 1st spike.
    c. Shunting inhibition needs to occur at any point prior to the 2nd EPSP.
    d. Shunting inhibition needs to occur at any point after the 2nd EPSP.

<u>The following set of questions require critical thinking beyond what was explicitly done in the lab:</u>

12. [Critical Thinking] In activity 2 you determined the dynamic range for a particular neuron. Would the brain be able to tell from the response of the simulated neuron whether the stimulus strength, i.e. the input current, doubled in relation to a stimulus with the maximum firing rate? Why or why not? How might the brain overcome this limitation?
