**MIDTERM EXAM**
Introduction to Neuroscience – Bio 3411
2000

A. (10 Points): Some answers are used more than once. (There are 10 correct answers; -1 for each answer over 10).

____ a. Point furthest from \( E_{cl} \)

____ b. Point closest to \( E_{ca} \)

____ c. The driving force on \( K^+ \) is greatest

____ d. The electrical gradient for \( Na^+ \) is inward

____ e. The electrical gradient for \( K^+ \) is zero

____ f. Point closest to the reversal potential for glutamate activated channels

____ g. Point furthest from the reversal potential for \( Na^+ \) channels

____ h. The driving force on \( K^+ \) is smallest

B. (8 points): Fill in the table with the letter of the correct concentration of bulk solution for mammalian neurons. Some answers are used more than once. Answers are best approximations.

\[
\begin{align*}
a. & \quad 143 \\
b. & \quad 5 \\
c. & \quad 0.0001 \\
d. & \quad 110 \\
e. & \quad 2 \\
\end{align*}
\]

(units of all solutions = mM)

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<tr>
<td>( Na^+ )</td>
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<td>( Ca^{++} )</td>
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<td>( K^+ )</td>
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C. (10 points): True of False (½ point each)

_____ 1. Myelin serves two major roles: 1. Lowering membrane resistance to increase the length constant, and; 2. Raising membrane capacitance to conserve energy.

_____ 2. Resistors in series add so that the total resistance is equal to the additive sum of all resistors.

_____ 3. Capacitors in series add so that the total capacitance is equal to the additive sum of all capacitors.

_____ 4. Spatial summation applies only to EPSP’s, and not IPSP’s.

_____ 5. The brain is wired mostly in series; parallel circuits are only occasionally encountered.

_____ 6. Each element of circuitry (neuron) in the brain is its own battery.

_____ 7. Each element of circuitry in the brain is a computer.

_____ 8. Synapses connecting neurons with other neurons most commonly produce all-or-none responses.

_____ 9. The reversal potential for a gaba receptor channel is the same as the equilibrium potential for chloride.

_____ 10. The bulk concentration of calcium ion remains constant in the presynaptic terminal, even during intense synaptic activity.

_____ 11. The driving force on a sodium ion is zero at the potassium equilibrium potential.

_____ 12. Myelinated neurons conduct an action potential at the speed of light.

_____ 13. Passive propagation is conducted at the approximate velocity of a fast pitched baseball.

_____ 14. Metabotropic receptors seldom use a second messenger system.

_____ 15. Ionotropic receptors require phosphorylation to function.

_____ 16. Active propagation relies on passive propagation to bring adjacent membrane to threshold.

_____ 17. Neuropeptides always bind to ionotropic receptors.

_____ 18. At the reversal potential of the Ach channel, the inward $K^+$ current is equal and opposite to the outward $Na^+$ current. (Assume the channel is open).

_____ 19. Even without the $Na^+ / K^+$ ATP-ase most cells would have a negative intracellular potential.

_____ 20. Saltatory conduction refers to active propagation jumping from internode to internode at the speed of light.
D. (1 point per blank): Fill in the blanks

1. Two main types of neurotransmitter receptors are the ____________________ type and the ____________________ type.

2. A neurotransmitter that is broadcast to more than one post-synaptic target is ________________.

3. A neurotransmitter that has its action stopped by a protease is ________________.

4. A drug that blocks the re-uptake of a neurotransmitter is ________________.

5. The cellular basis of learning and memory probably involves use-dependent synaptic mechanisms such as ____________________, ____________________, and ____________________.

6. “Place learning” in the hippocampus probably involves what synaptic mechanism? ________________.

7. Short-term learning and memory may involve synaptic plasticity while long-term memory may involve ________________.

8. In addition to functioning to carry a signal over long distances, action potentials also function in the brain as ________________.

9. Which four answers are applicable to the diagram: _____; _____; _____; _____
   a. Facilitation
   b. Presynaptic Facilitation
   c. Depression
   d. Spatial Summation
   e. Temporal Summation
   f. Long-term potentiation
   g. IPSPs
   h. EPSPs
   i. Electrical Synaptic Transmission
   j. Passive Potential

10. a, b, & c refer to types of genetic mutations. Choose the best answer.
    a. Recessive       b. Dominant-negative       c. Dominant-gain of function

    _____ Sodium channel defect causing symptoms similar to hyperkalemia.
    _____ Loss of function; most common type of mutation.
    _____ Benign familial neonatal convulsions.
    _____ Usually involves a multimeric protein.
    _____ Long Q-T syndrome.
11. One type of potassium channel we have not discussed is called the A-current channel. It is rapidly activating and inactivating and has an inactivated state resembling that of the Na\textsuperscript{+} channel.

![Diagram of potassium channel with rapid inactivation]

This channel is also present in the heart. Choose the point where it is active in the cardiac action potential. 

E. (1 point): Multiple Choice: Circle correct answer(s)

Synaptic integration may involve which of the following:

a. Facilitation
b. Depression
c. Temporal Summation
d. Presynaptic Inhibition