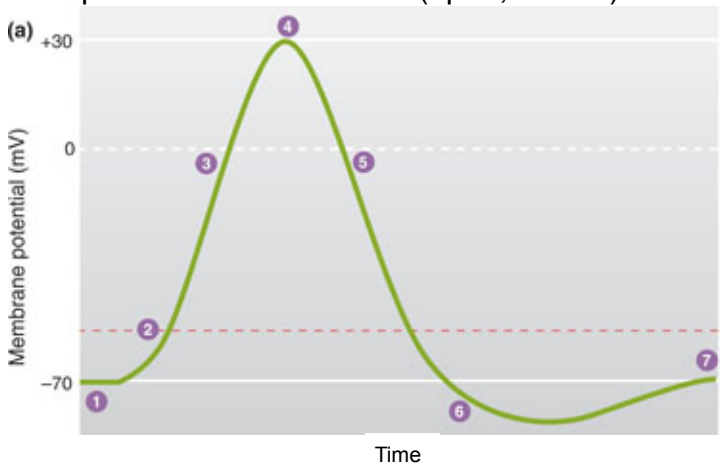
Homework Assignment – Module 2

1. [20 points[1]] The Figure (below) shows the membrane potential *vs.* time for an action potential fired on the membrane of an excitable cell; the Table (below) indicates the state (open or closed) of the sodium channel gates and of the potassium channel gate at some of the various labeled time points (1, 2, … 6, 7) during the action potential. Please fill in (open, closed) the blank entries



Time Point	Na^+ channel		K^+ channel
	Activation gate	Inactivation gate	
1	closed	open	closed
2	open	open	closed
3			
4	open	closed	open
5			
6			
7	closed	open	closed

2. [20 points] With reference to a post-synaptic membrane, explain the mechanism(s) of, and differentiate between, *spatial summation* and *temporal summation*.

[1] 2 points for each correct response plus 2 points to add up to 20 points.

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3. [5 points] With reference to the conduction of action potentials and/or sub-threshold changes in membrane potential along the axons or dendrites of neurons, indicate the most correct statement among those given below:
   A. The propagation velocity of action potentials in unmyelinated axons is inversely proportional to axon diameter.
   B. The conduction velocity of action potentials in an unmyelinated axon of diameter 10 μm will be higher than in a myelinated axon of diameter 1 μm.
   C. Saltatory conduction (of an action potential) does not occur in unmyelinated axons.
   D. In a myelinated axon the cells that wrap around the axon are wrapped most thickly at the Nodes of Ranvier.

4. [20 points] How would the action potential on the cell membrane of an electrically excitable cell change (amplitude and time course) if the ratio of maximal to minimal g_{Na} was 80% of that in a "normal" electrically excitable cell? Assume that the value of the minimum g_{Na} is the same as in a "normal" cell. **NOTE: The statement of the problem is intentionally a bit vague – you will have to make some assumptions. Make sure to explicitly state any assumptions that you make in order to answer this question.**

5. [5 points] Consider a synapse in which the binding of a neurotransmitter to a receptor on the postsynaptic membrane causes a transient increase in K^+ channel conductance in the region immediately surrounding the receptor. Indicate the most correct statement among those given below.
   A. This will result in an IPSP if the resting membrane potential of the postsynaptic cell was less negative than the potassium Nernst potential for the postsynaptic cell.
   B. This will result in an EPSP if the resting membrane potential of the postsynaptic cell was less negative than the potassium Nernst potential for the postsynaptic cell.
   C. The potassium channel inactivation gates would transiently close in response to the binding of the neurotransmitter to its receptor on the postsynaptic cell.
   D. Such a change in the local potassium channel conductance of the postsynaptic cell membrane will always trigger an action potential.

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