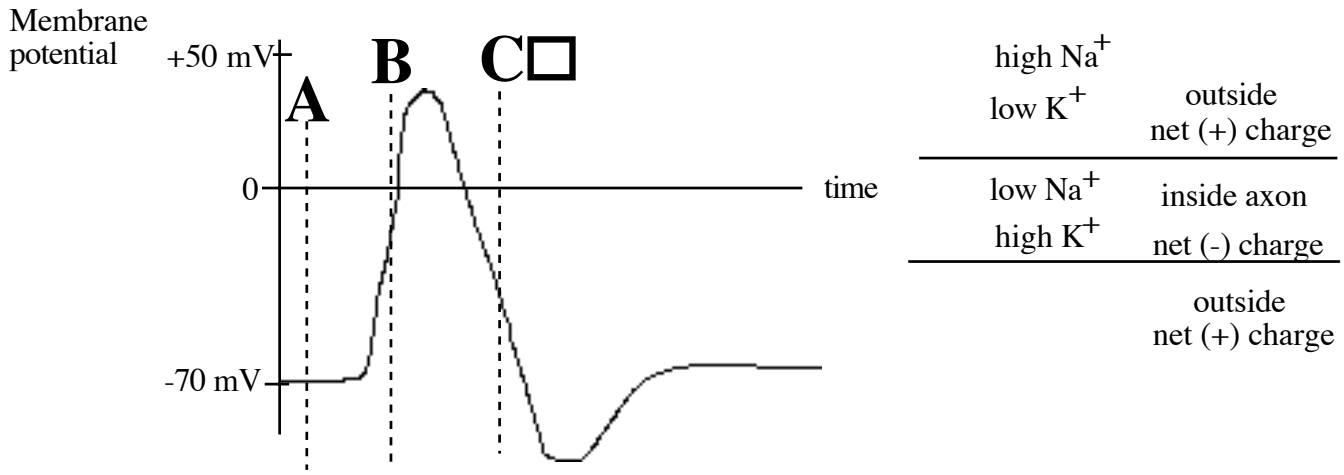
7.012 Neurobiology SECTION

Shown below is a graph of membrane potential as a function of time for an action potential traveling down an axon.



a) For each of the three time points indicated, fill in the following table the statuses of the sodium and potassium channels and the ion fluxes. Please use the terms provided.

	Time Point		
	A	**B**	**C**
Na^+ Channel status (**I**nactivated, **C**losed, **P**artially-open, **O**pen)			
K^+ Channel status (**I**nactivated, **C**losed, **P**artially-open, **O**pen)			
Na^+ Flow (**in**to axon, **none**, **out** of axon)			
K^+ Flow (**in**to axon, **none**, **out** of axon)			

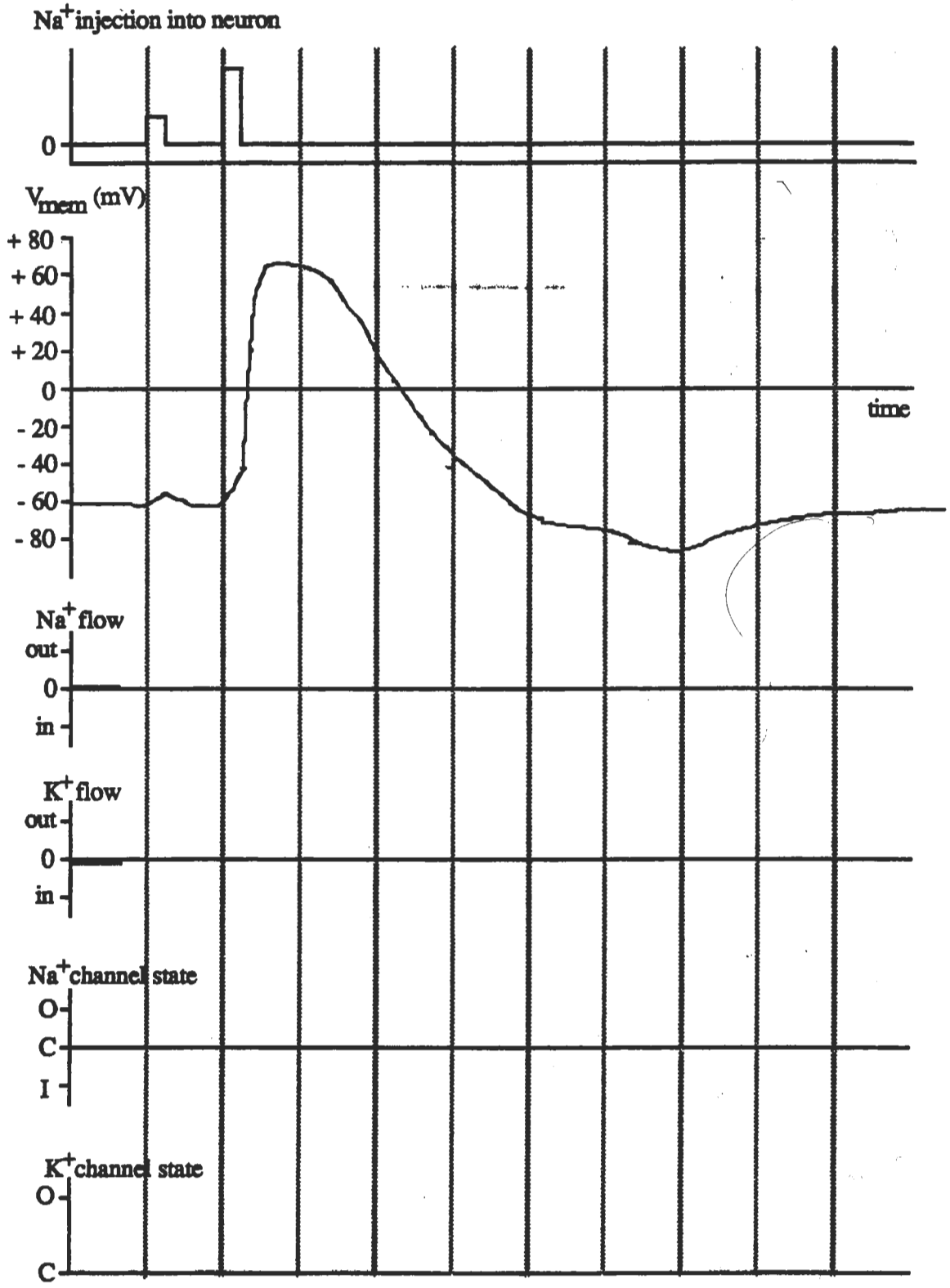
7.012 Section problem:
The Ionic Basis of Action Potentials

You perform the following experiment on a normal neuron. You measure the following parameters of a small region of the axonal membrane as a function of time:

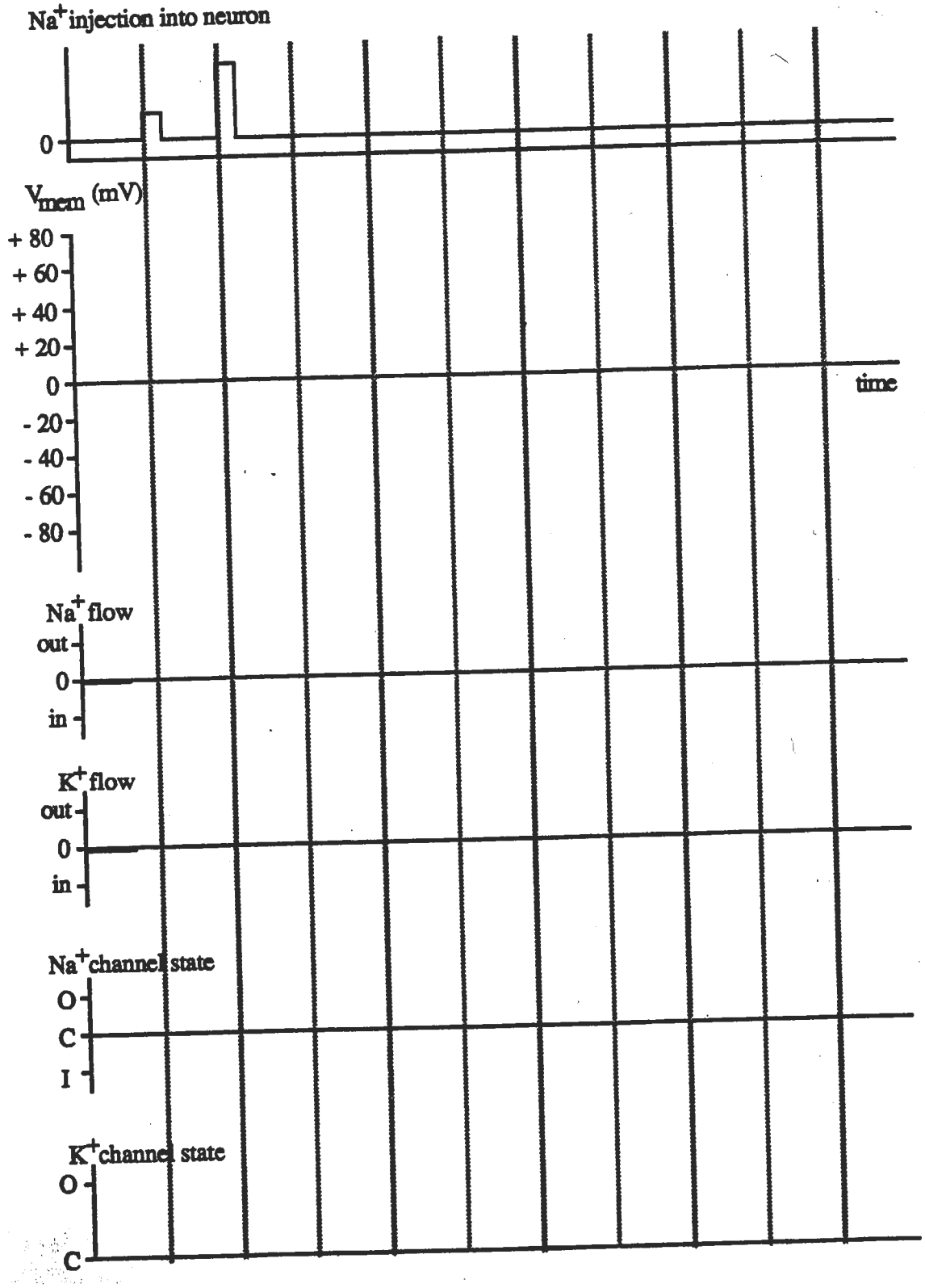
- membrane potential
- net direction and approximate magnitude of K^+ ion flow through axonal membrane
- net direction and approximate magnitude of Na^+ ion flow through axonal membrane (not including injected Na^+ ions)
- state of the voltage-gated Na^+ channels (open - O, closed - C, or inactivated - I)
- state of the voltage-gated K^+ channels (open - O or closed - C)

During the course of the experiment, you inject a small amount of Na^+ ions into the axonal cytoplasm in the region where we are measuring the above parameters. The first injection results in a sub-threshold depolarization (no action potential fires) and the second results in an action potential. These injections of Na^+ ions are shown on the top line of the next page.

a) For a normal neuron, fill in the remaining parameters on the following diagram as a function of time for the region of membrane we are studying.



b) In a separate experiment, you pre-treat the neuron with a drug that blocks the voltage-gated Na^+ channels and then perform the same injection experiments. On the graphs below, predict the resulting behavior of the neuron.



c) In a third experiment, you pre-treat the neuron with a drug that prevents the K^+ channels from opening wider when the neuron depolarizes (the constitutive K^+ leak channel is still open) and then perform the same injection experiments. On the graphs below, predict the resulting behavior of the neuron.