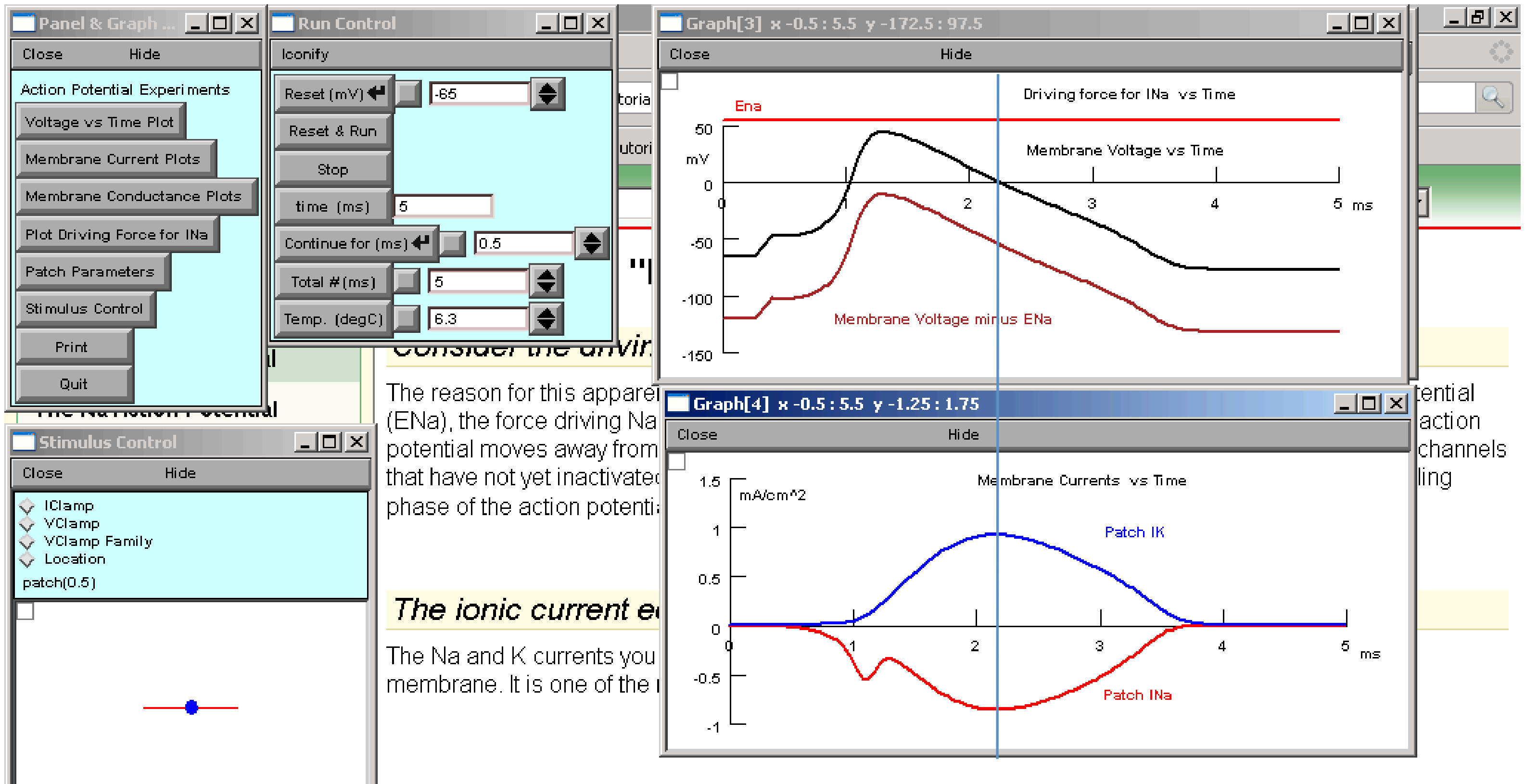
Completed Lab G

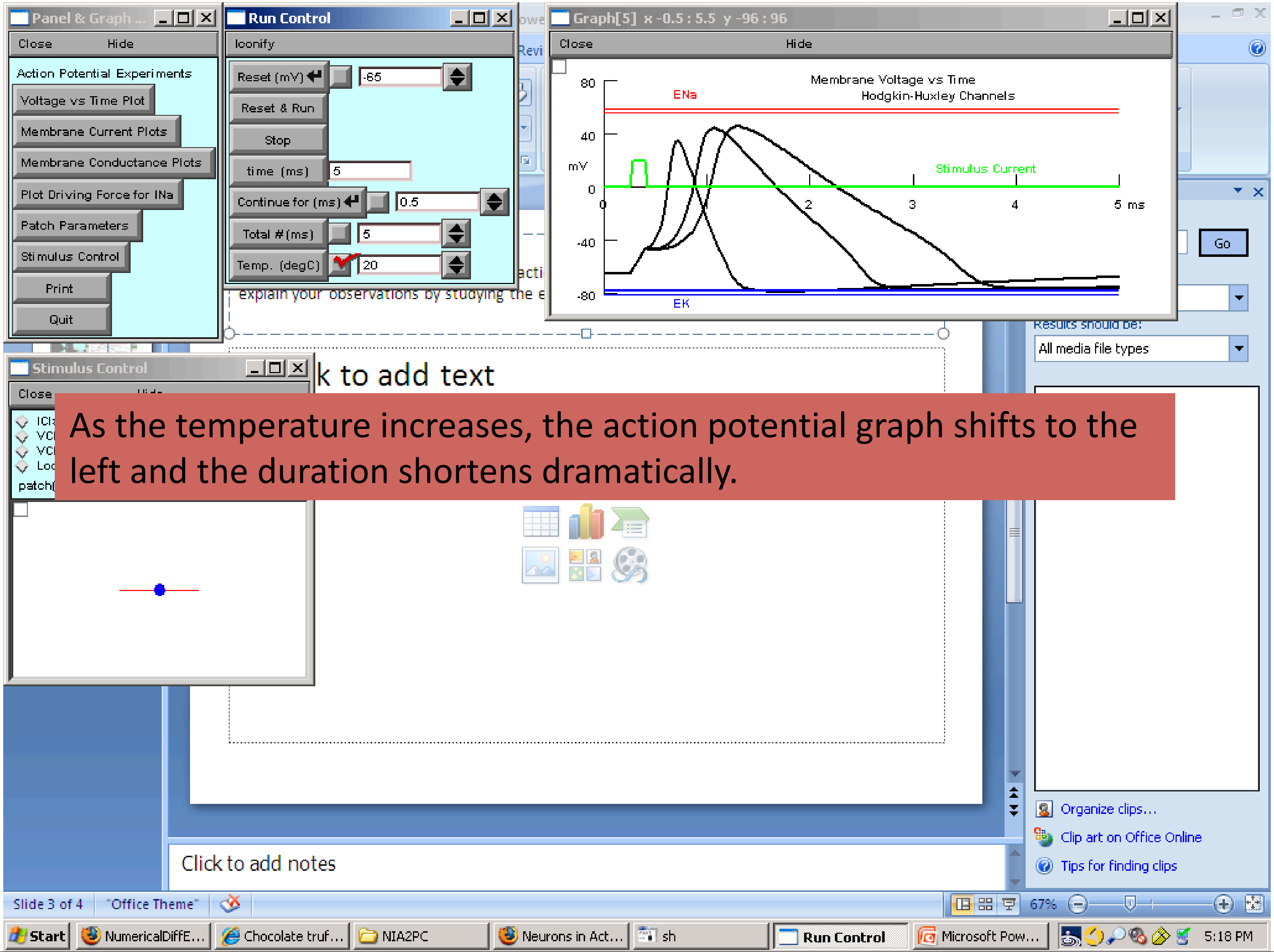
With Bonus

Why is INa so "kinky" with two phases? Why does it not have a smooth time course since the voltage and gNa—and even IK—all have smooth time courses?



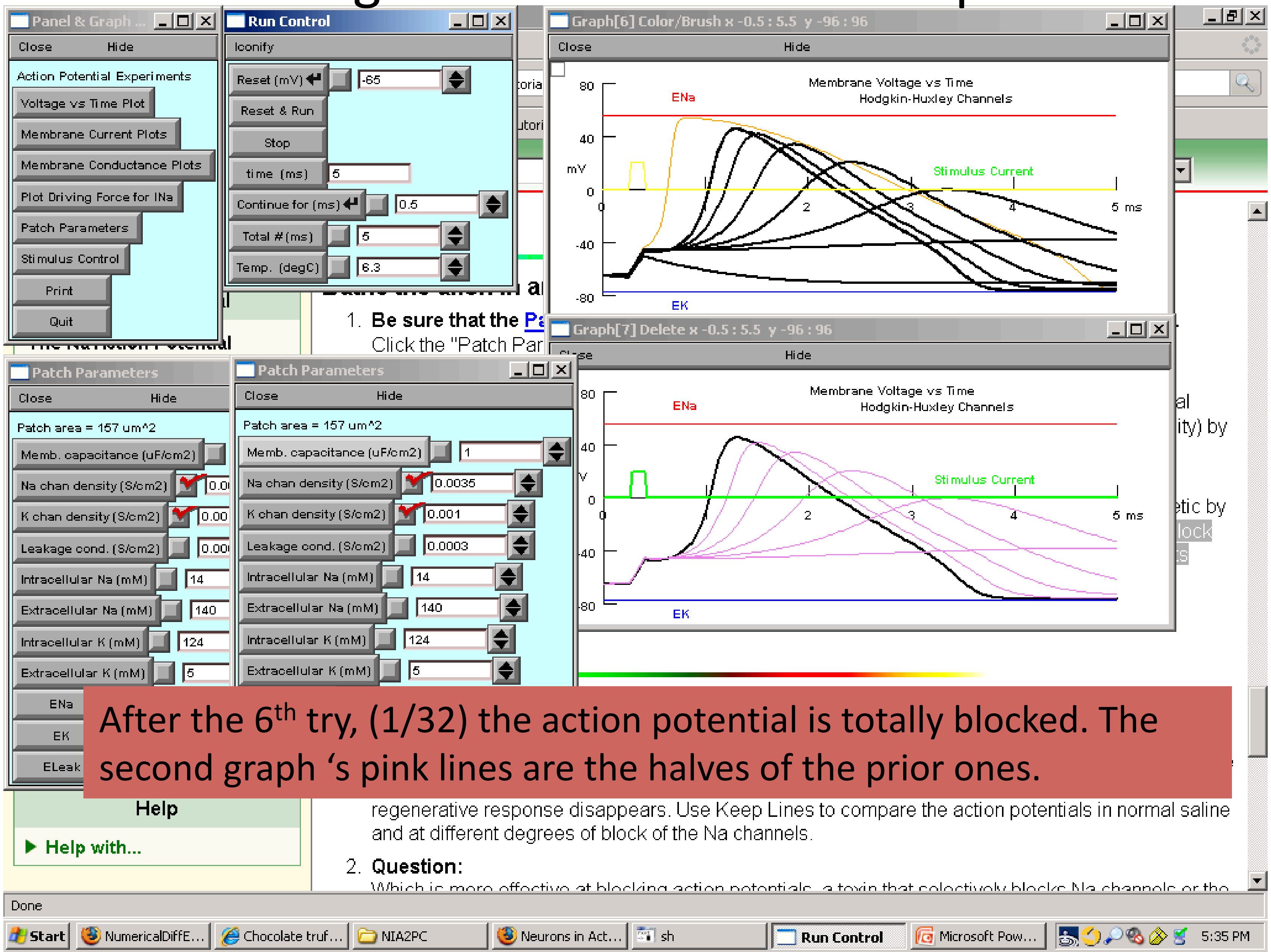
To solve the main problem at the top, membrane current versus time graphs were graphed and analyzed. The minimum point (x=2.25)on the Patch Ina matches the x-intercept of the first graph. As the action potential approaches the Na equilibrium potential (ENa), the force driving Na ions through the membrane approaches zero. Thus INa is reduced but again increases when action potential falls. The Na current is actually largest during the falling phase of the action potential.

What happens to the duration of the action potential if you change the temperature? Can you explain your observations by studying the effect of temperature on the underlying conductances?



As the temperature increases, the action potential graph shifts to the left and the duration shortens dramatically.

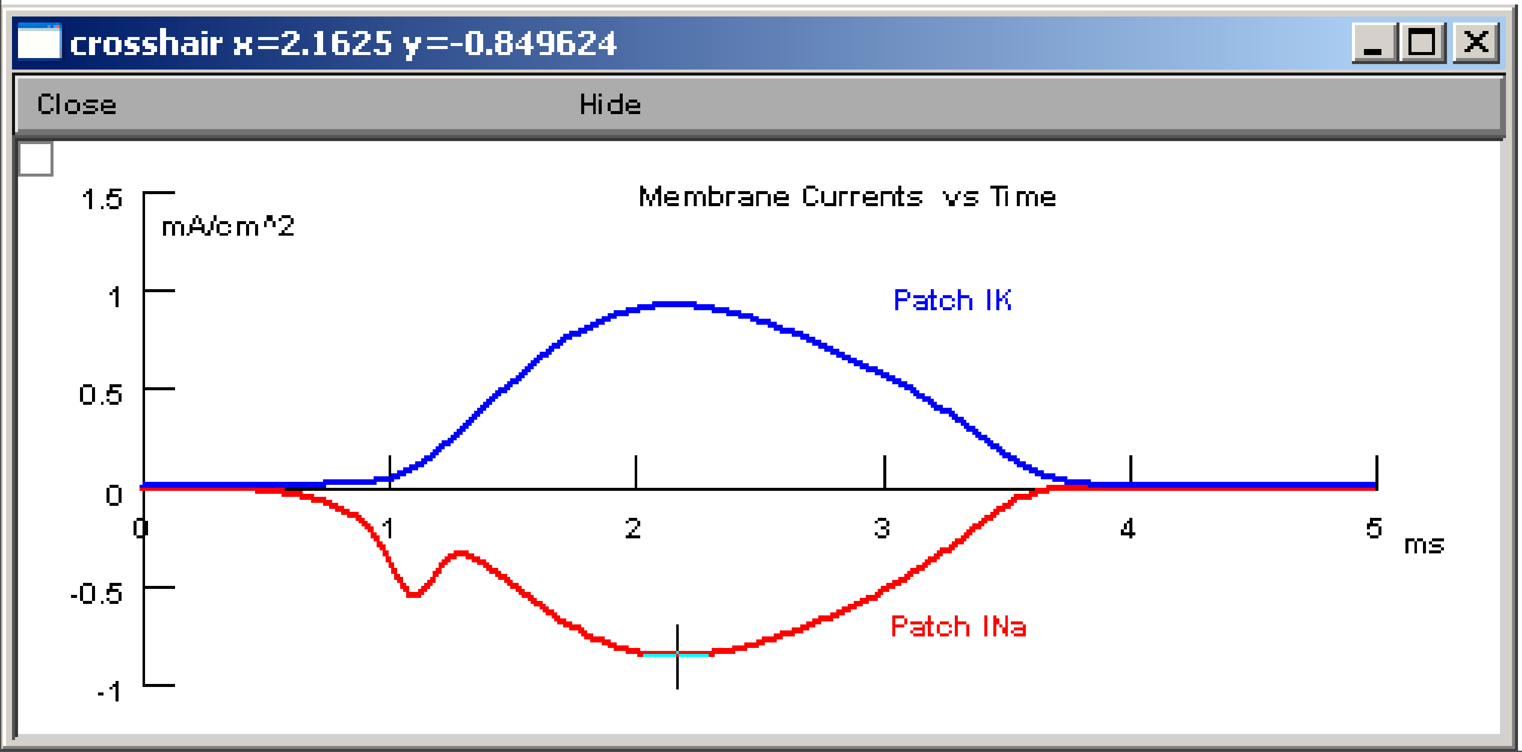
By how much must you reduce the two conductances to block the generation of the action potential?

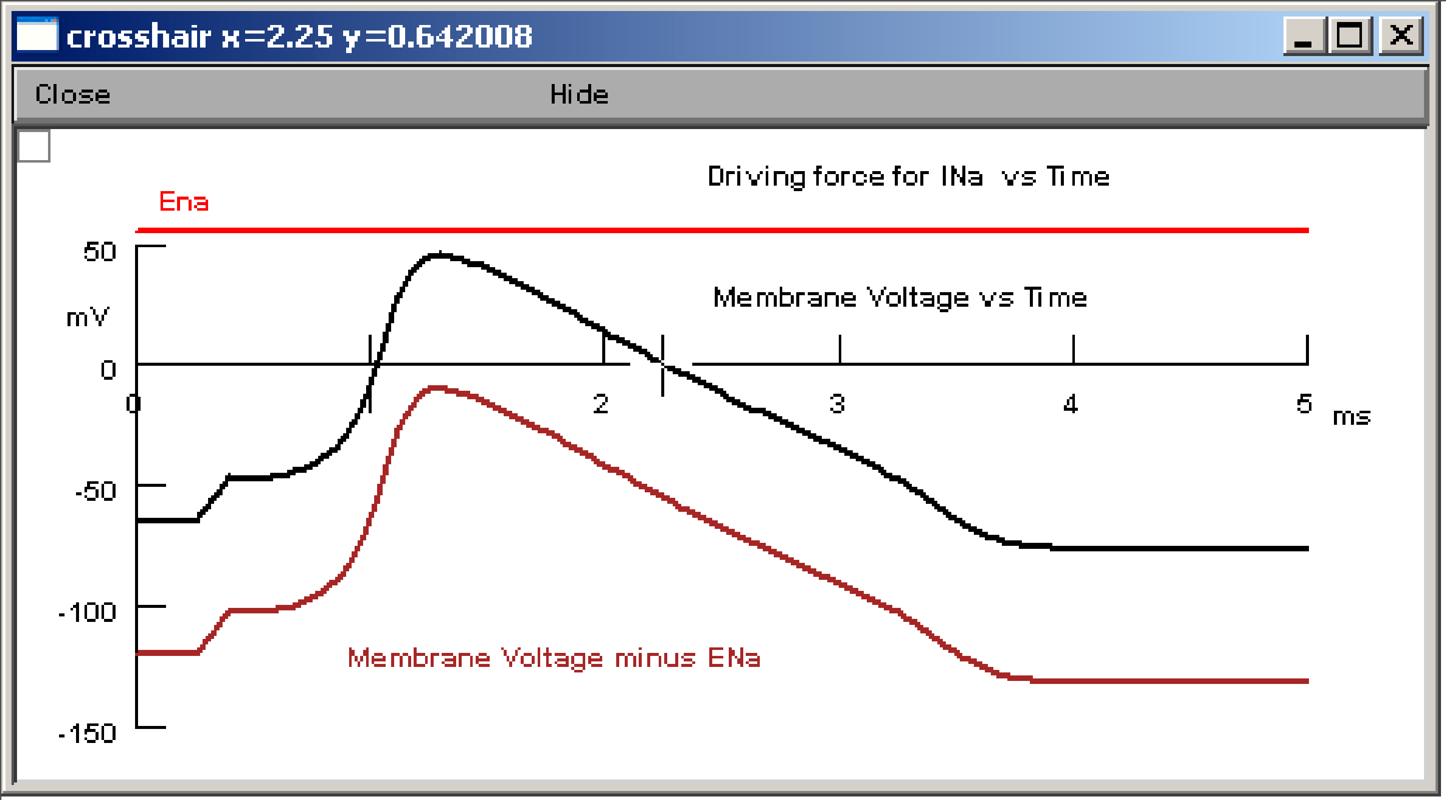


After the 6th try, (1/32) the action potential is totally blocked. The second graph 's pink lines are the halves of the prior ones.

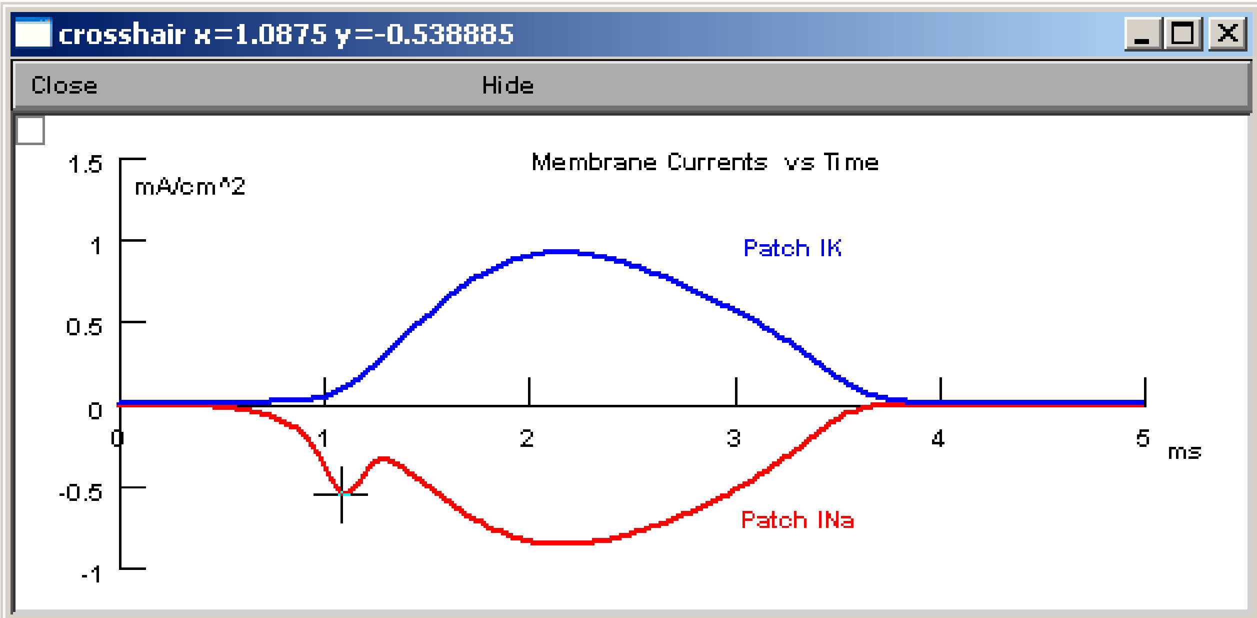
Observation 1

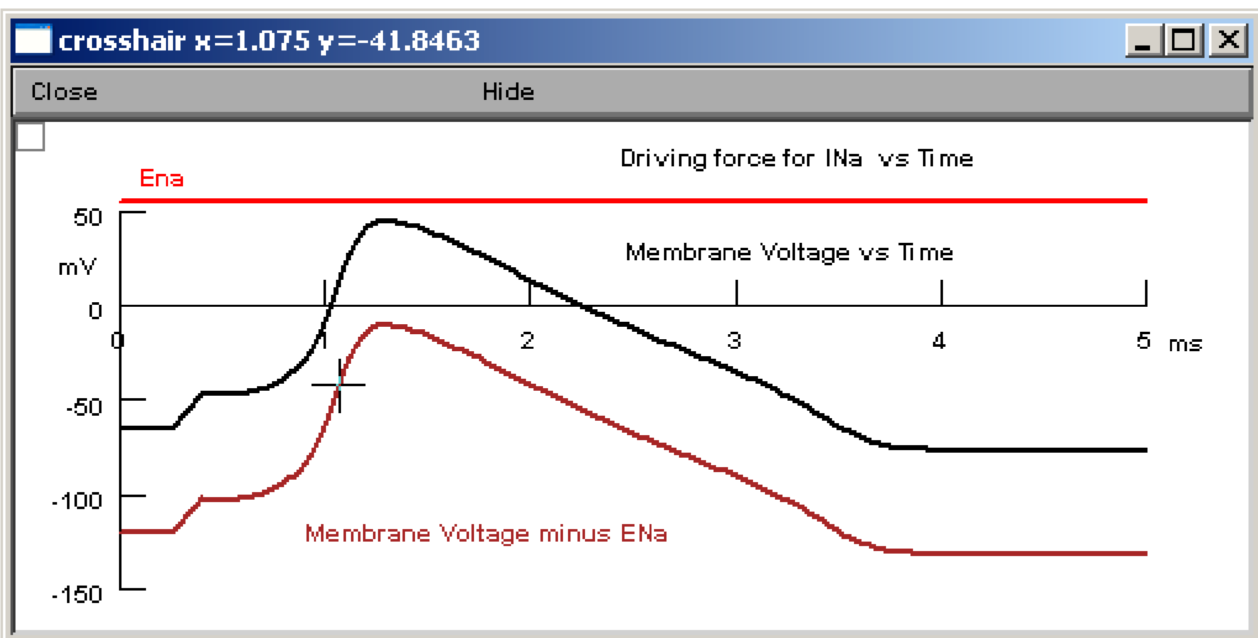
- To address the question “Why is INa so ‘kinky’ with two phases?” I found the time at which the minimum INa occurs from the Ina vs time graph.
- The time was found to be around 2.16 ms





- 2.16 ms was the time at which membrane voltage equaled 0.
- Therefore, the Na current is the largest at the falling phase.





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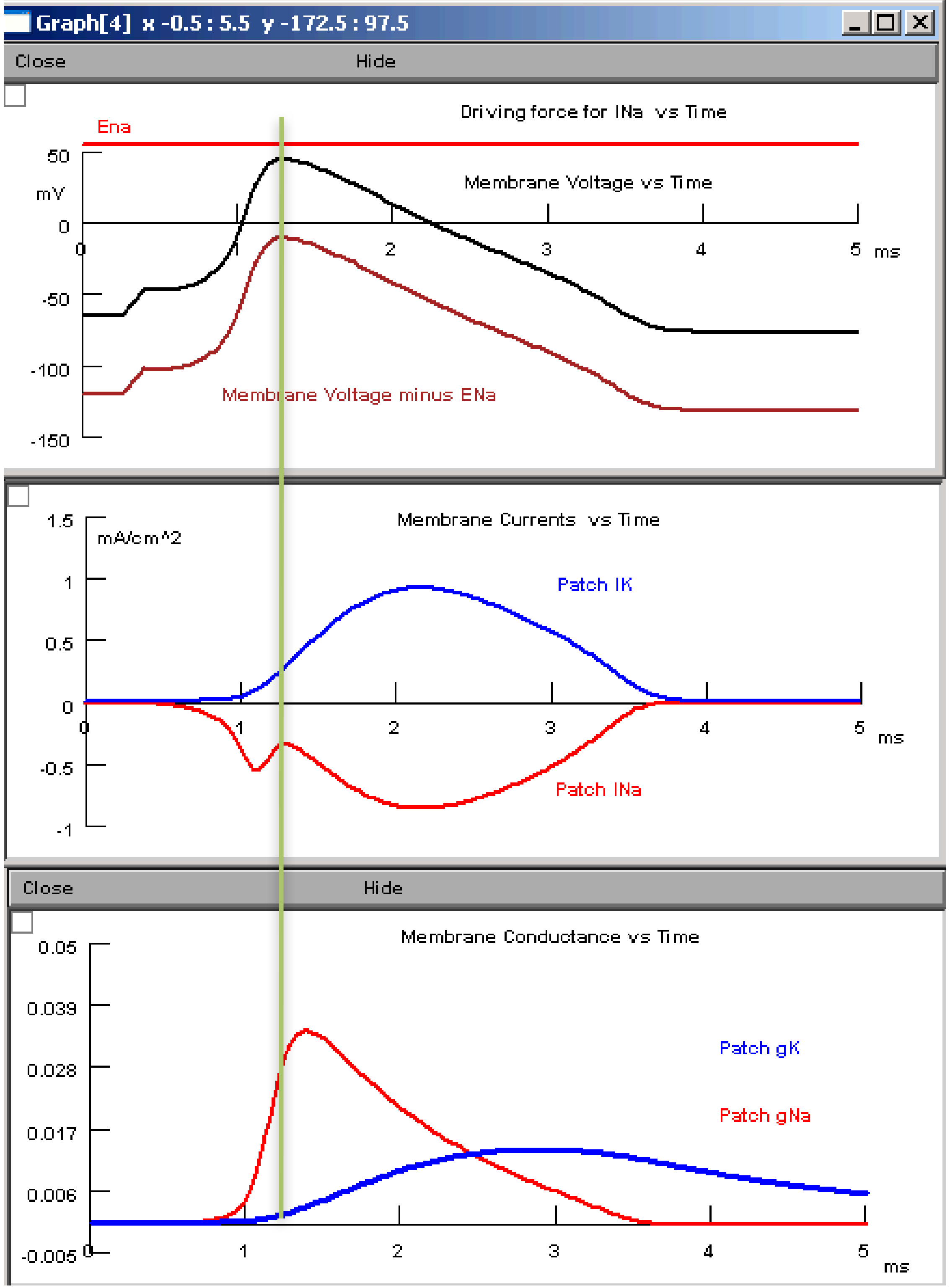
Notice that the kink in the sodium current corresponds to a time (1.1 msec) when the driving force for Na approaches zero (seen on the lower plot)—this is because the membrane voltage is approaching the ENa. As the membrane voltage moves away from Ena, we see that the Ina can increase again. The Na current is actually largest during the falling phase of the action potential—an unexpected result.

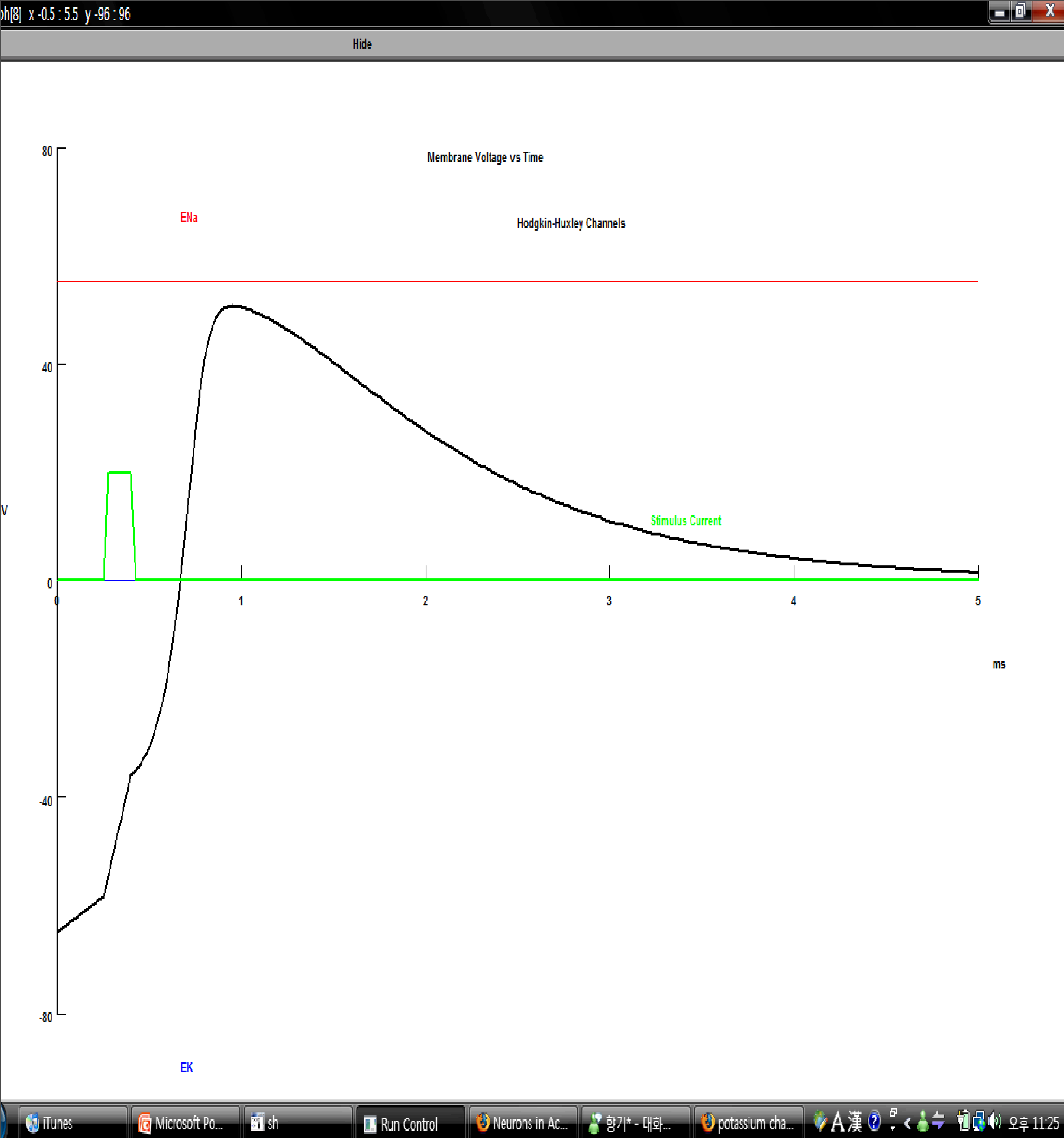


- When driving force is the least, INa into the cell decreases (green line)
- Greatest INa and gNA occur during the falling phase of action potential

Observation #4 : Bonus

The tutorial goes through the effect of TTX, the Na blocker, but what about TEA, K Blocker?

Same as TTX, one would expect the shape to be solely depended on Na driving force.



And just as expected, the shape is only depended on the flow of K ion.

Bonus Problem

Action potential fired with 3 separate currents at I = 0.07 nA, lasting for 0.05ms each. They are introduced closer together in time to generate action potential as a result of temporal summation. An individual current at I = 0.07 nA for 0.05ms will not fire an action potential under the same circumstances.