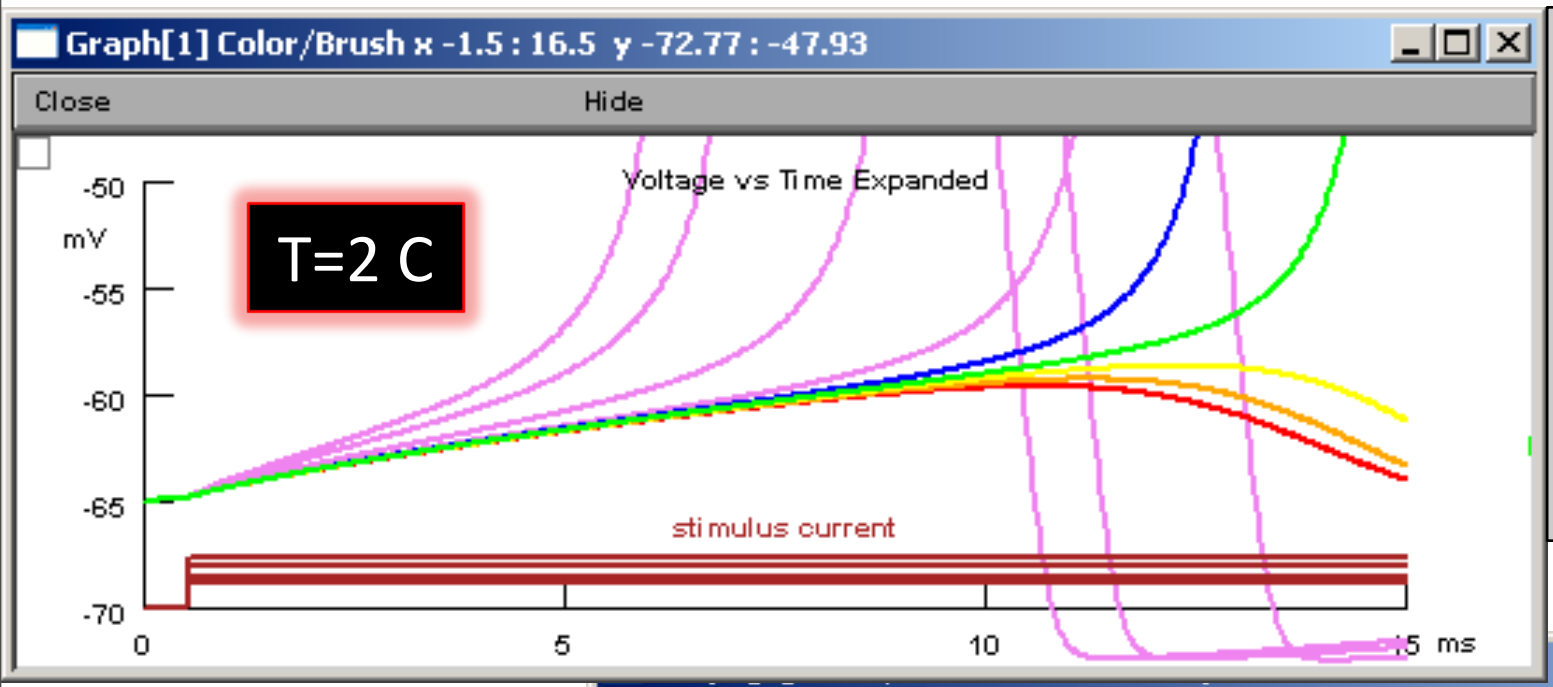
Lab H Completed

With Bonus

Temperature vs. Threshold



Amplitude:

1.15 nA

1.16 nA

1.17 nA

1.18 nA

1.2 nA

>1.2 nA

Amplitude:

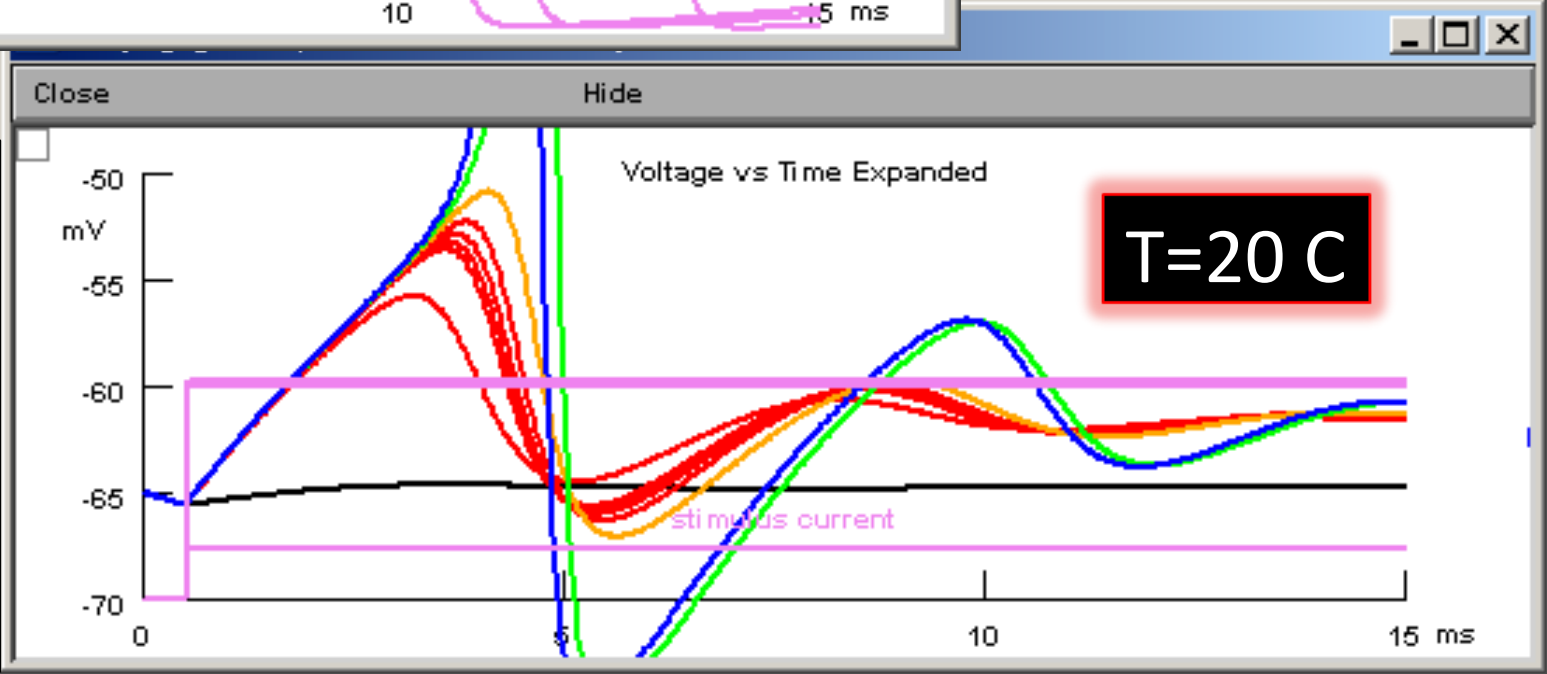
2.4 nA

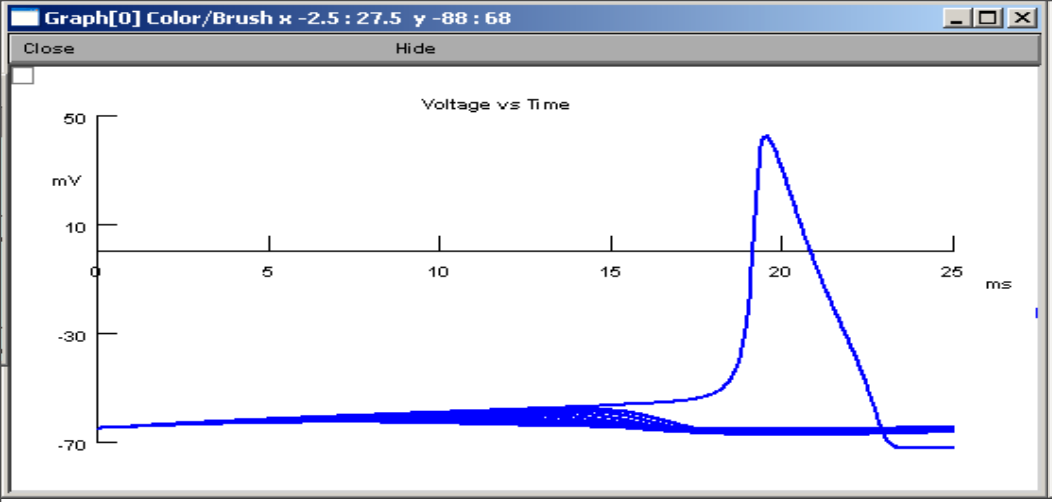
< 10.24 nA

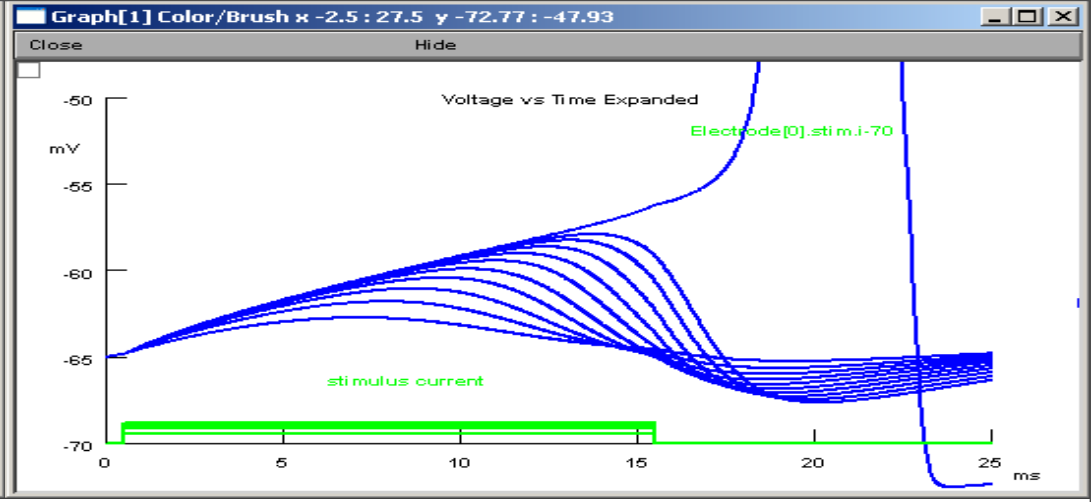
10.24 nA

10.25 nA

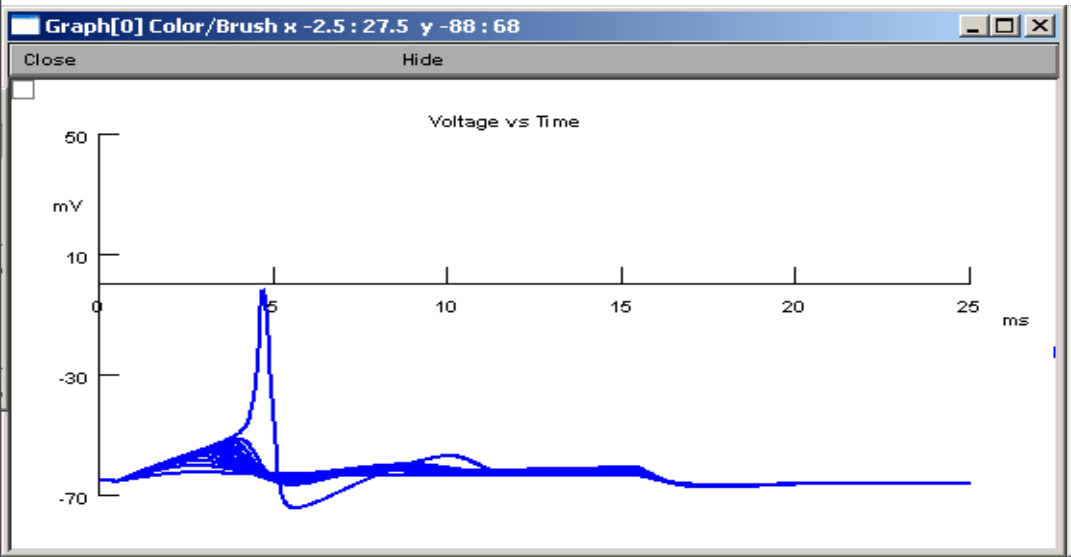
10.26 nA

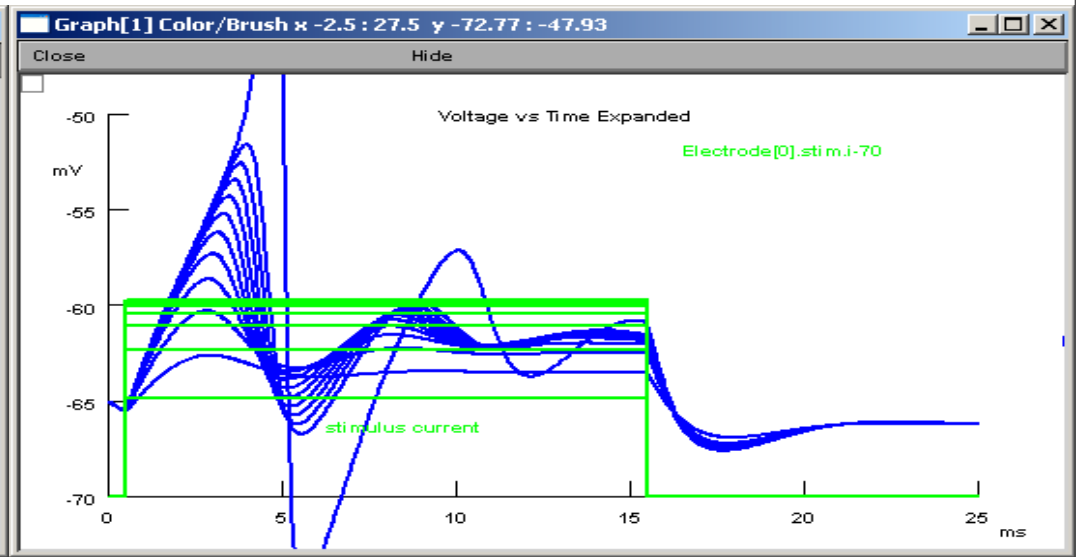






At 2 deg Celcius, the critical current threshold is at I = 1.1743 nA at which an action potential will be generated by the given neuron.

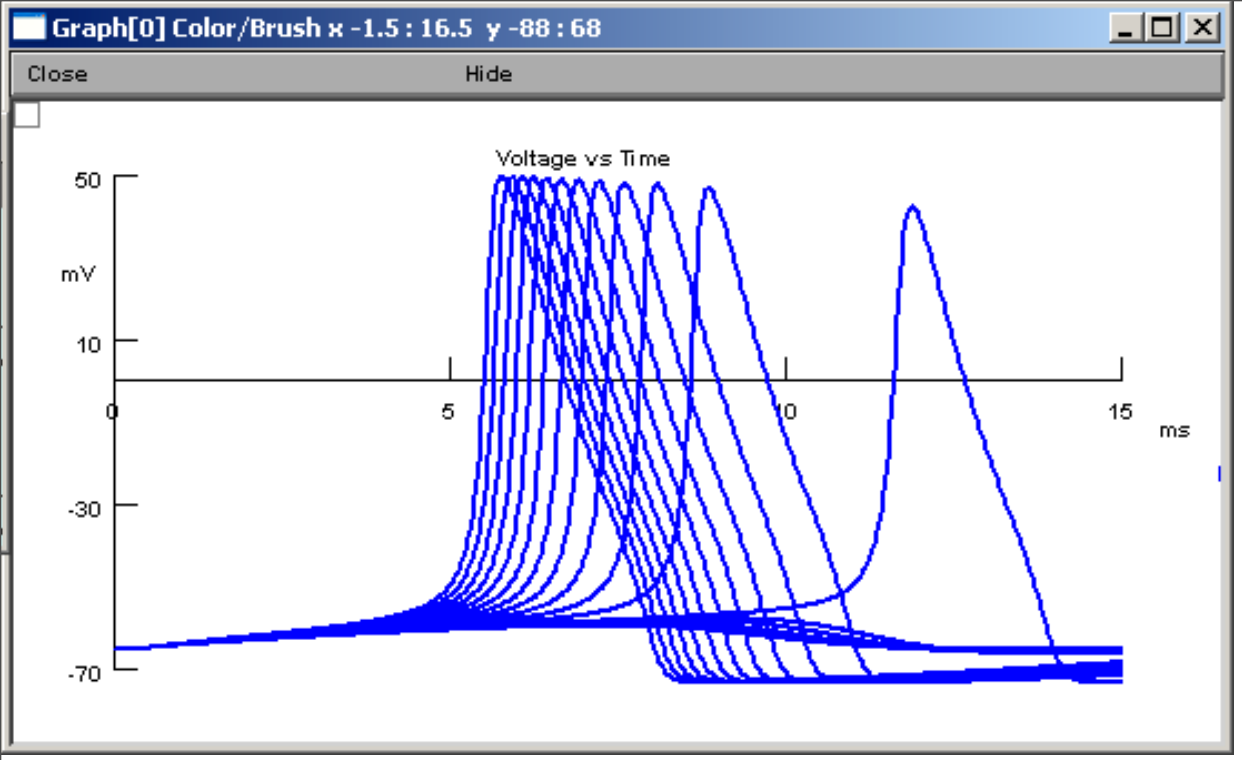




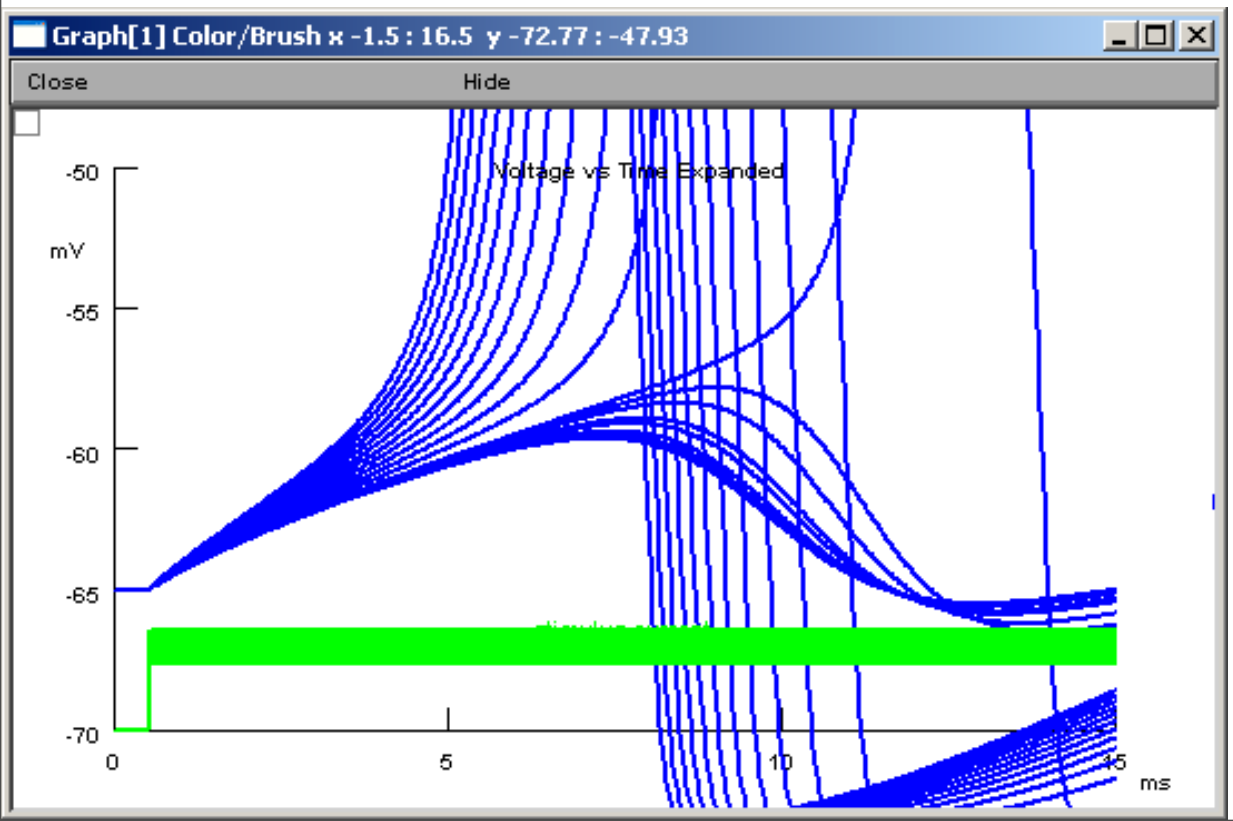
At 20 deg Celcius, the critical current threshold is at I = 10.242 nA. Much higher than the current required to generate an action potential at 2 deg Celcius.

At higher temperature, the membrane potential depolarizes at a faster rate because at higher temperature, the kinetics of the channels work faster, therefore depolarization is able to occur at a faster rate.

It must require greater amounts of current to generate an action potential at higher temperature possibly because the balance between the sodium ions and the potassium ions have changed. To get Na+ ions inside to trigger an action potential, more current needs to be injected when the neuron is at a higher temperature.

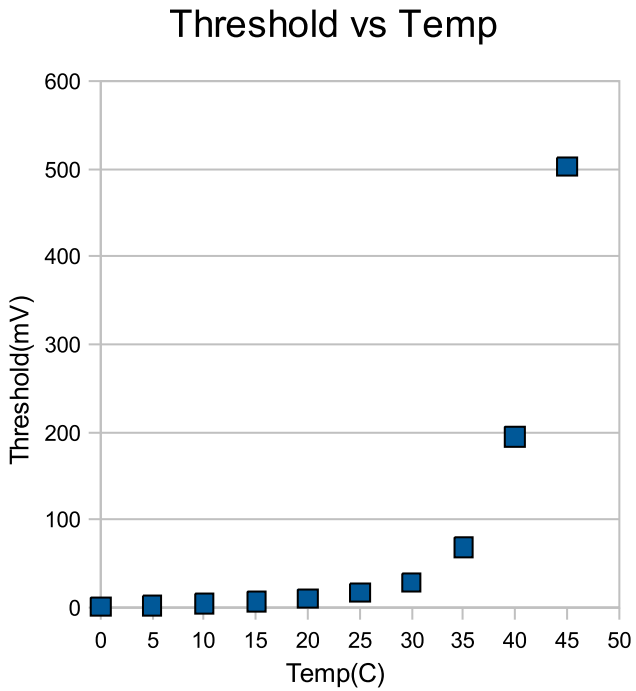


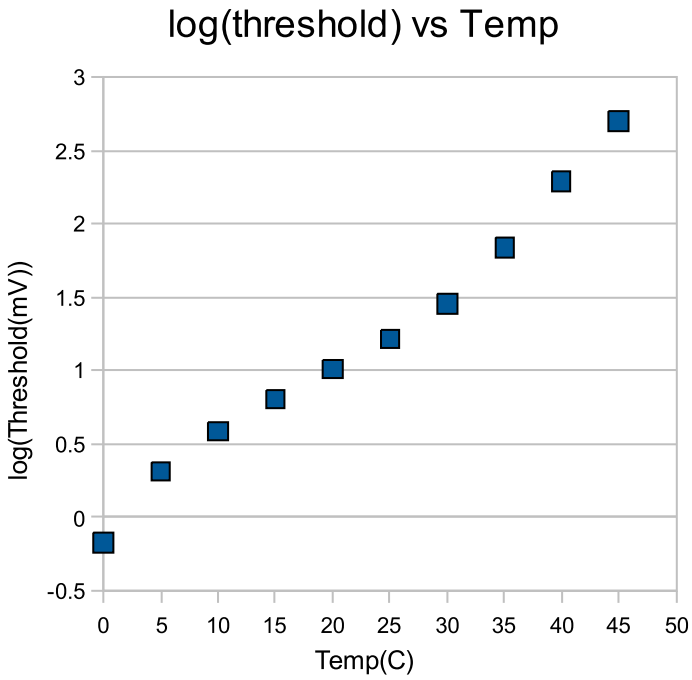
As the current amplitude increases, the maximum voltage peak increases for the action potential. This occurs because if the current amplitude is just above the current threshold value, then it takes a longer time for the neuron to generate an action potential and therefore K conductance turns on and reduces the amplitude of the action potential.



Side note: as the amplitude of the current increases, the action potential shifts to an earlier onset by a smaller amount of time. This occurs because HH model is a non-linear system. If the neuron only had leak channels, the shift in the onset time will change equally along all change in values of the current amplitude change.

Bonus Problem: Threshold as a function of temperature

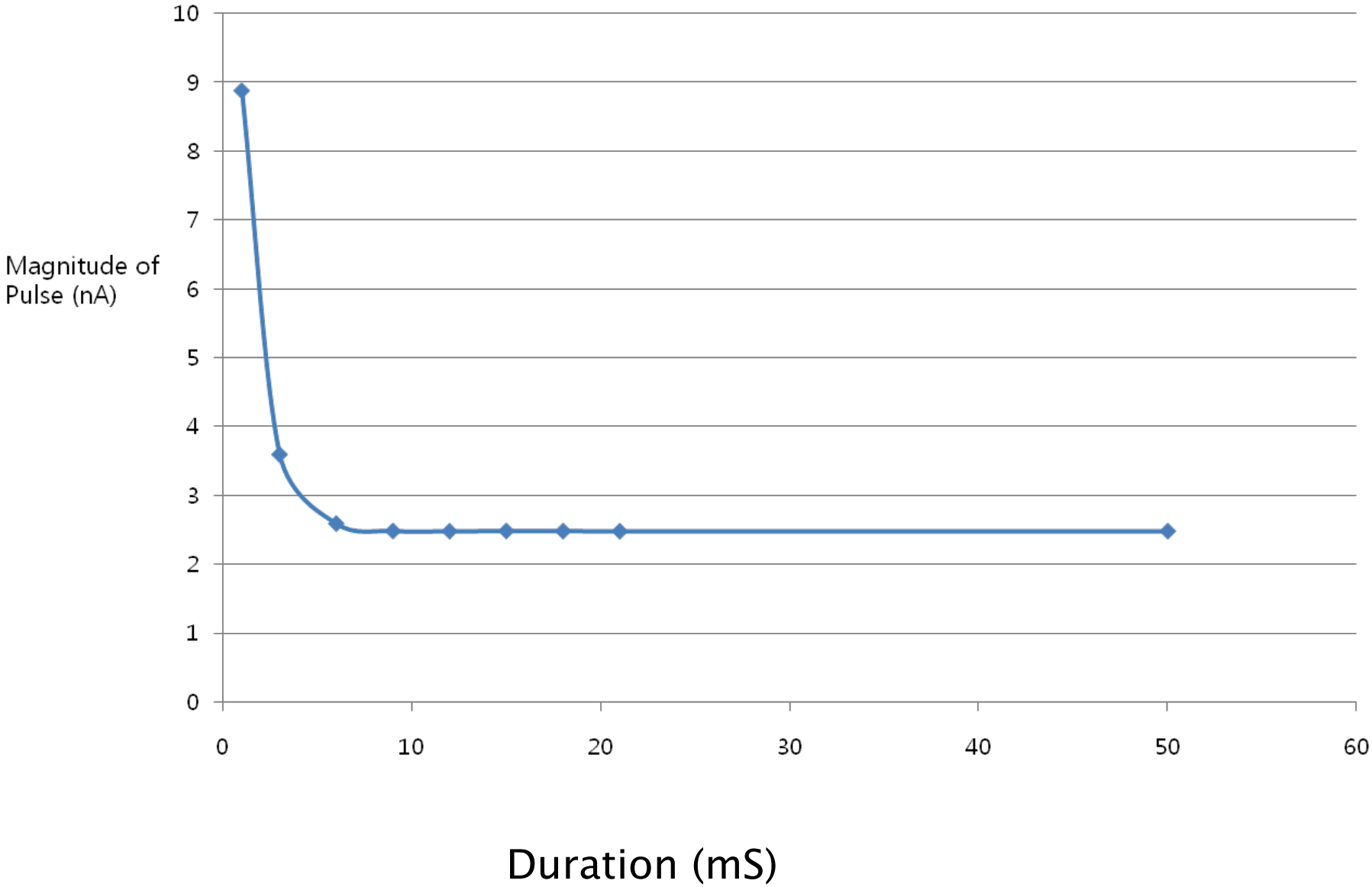




Observation 4 - Bonus Problem

I will find the exact relationship between duration and magnitude of the pulse required to fire action potential using graph.

Graph


Magnitude of Pulse (nA)
10
9
8
7
6
5
4
3
2
1
0
0
10
20
30
40
50
60
Duration (mS)

Conclusion

- If the duration is significantly short, it requires increased magnitude of pulse to fire action potential. If the duration is longer however, it takes equal amount of pulse to fire action potential. The relationship is not direct but there is a cut off point.