Simulation Exercises – Synaptic Transmission Part 1

Here are two questions from past Exams to get you primed:

> (10 points) You are recording membrane potential from a neuron that has a resting potential of -55 mV. When you apply a very brief dose of GABA to the cell, the membrane hyperpolarizes to -60 mV then returns to resting potential. You have the ability to inject a steady current to hyperpolarize or depolarize the cell as you deliver GABA. You also have the ability to change the concentration of any ion outside the cell. Describe three tests you could run to establish whether the receptor is a potassium channel or a chloride channel. You can assume that ENa is +55 mV and EK is -90 mV.
>
> (10 points) You are recording membrane potential from a neuron that has a resting potential of -60 mV. When you apply a very brief dose of glutamate to the cell, the membrane depolarizes to 55 mV then returns to resting potential (an EPSP). You have the ability to inject a steady current to hyperpolarize or depolarize the cell as you deliver glutamate. You also have the ability to change the concentration of any ion outside the cell. Describe how you would establish the reversal potential for this EPSP, and how you would determine whether NMDA receptors are present in your cell. You can assume that ENa is +55 mV and EK is -90 mV

This simulation is designed to teach you how to think about synaptic transmission in a way that would let you answer these exam questions. Using the SimCC simulation program, load and run the simulation file AnalyzePSP.CC5. This file simulates an experiment where you are recording the membrane potential from a target neuron, while you are stimulating presynaptic neurons that release both GABA and glutamate onto your target cell. Notice the brief EPSP followed by two IPSPs, one that is fast and brief and another that is slow and long.

Your task is to answer these four homework questions:

1. What is the reversal potential the fast IPSP, and what is the charge carrier for this IPSP? How did you determine this?

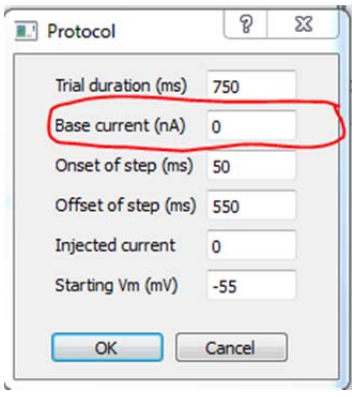
2. What is the reversal potential for the slow IPSP, and what is the charge carrier for this IPSP? How did you determine this?

3. What is the reversal potential for the AMPA PSP? How did you determine this?

Here are the rules: All you can do is this –

1. Change the ionic concentrations outside the cell
2. Depolarize or hyperpolarize the cell by changing the base current,
3. Block GABA or Glutamate receptors by setting their weights to 0.

1.



2.