Some general perspective:

1. The exams are designed to assess three things:
    a) your mastery of the key facts
    b) your mastery of general principles (more important than facts
    c) how well you can apply these facts and principles to explaining neuronal function.

2. The exams are hard. It is very possible that no one will be able to answer all the questions on the exam. Don't be alarmed by this.

3. There will be no calculation questions on the exam. For things like Ohms law, the Nernst Equation, and the GHK equation, what you need to know are the principles that these equations embody.

Some help for studying:

1. Old quizzes are a very good indication of the factual topics that might appear on the exam. However, there will be no multiple choice questions. You will need to be able to produce the answers, which is always more difficult than recognizing the correct answers.

2. The simulation assignments and homework assignments are very good indications of the general principles that I want you to understand. Review the simulations and your homework assignments and ask yourself: "What were the take-home messages from these." Ask yourself, "why did he choose these particular questions/simulations/assignments?"

Some sample questions to illustrate the type of questions that will appear on the exam:

Note: some of these might appear on the exam, but also be prepared for questions that don't appear here!

- Name three changes in ionic currents that would increase the maximum firing rate of a neuron and explain how each would increase the firing rate.

- Draw an IV curve for a sodium current that activates at -45 mV, peaks at -0 mV, and reverses at +60 mV.

- Label as many parts of this this ion channel subunit as you can [picture will be provided], and describe the part's function if it isn't clear from your label.

- Name and explain two key functional properties for voltage-gated ion channels

- Sketch what current through a single delayed-rectifier potassium channel would look like. Under that, sketch what the current through a population of delayed-rectifier potassium channels would look like.

    - Pick one of these phenomena. Explain it, then draw and label a graph that could be used to measure it.
        - Spike frequency adaptation
        - Dynamic range of firing frequencies

- What would be the best passive properties for a cell that has to respond quickly to high-frequency sensory information?

- What would be the best passive properties for a cell that has to integrate multiple sensory inputs over time?

- List three processes in neural function where Ohms law is important. Explain how Ohms law helps to explain or understand that process.

- Explain why you can't be sure that potassium will exit the cell if all you know is that potassium channels are open

- Explain the equilibrium potential for an ion species.

- At any given moment during an action potential, what determines the size of the sodium current across the membrane.

- Below is a figure from an article in The Journal of Neuroscience. The experimenters recorded from neurons in the cortex of normal mice (wild type) and mice that were missing the gene for a particular type of ion channel (HCN1 KO). The experiment delivered a train of five excitatory postsynaptic currents to the cell and measured membrane potential (MP). From the data shown in Panel B, what do think bicuculline and ZD-7288 are doing to sodium leak channels in the cell? From the data shown in Panel D, what do you think were the effects of the drug bicuculline in cells from the HCN1 KO mice?

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