Question 1a
The toxin *ouabain* has been used for hunting purposes in Africa. The source of ouabain is the ouabaio tree (*Strophanthus gratus*). At sufficient dosage, it completely inhibits the sodium/potassium pump (ATPase). What happens if you apply ouabain to a neuron? Explain.

Question 1b
Would you expect the loss of membrane potential to be faster or slower if an action potential were triggered in the neuron once the ATPase was inhibited? Present your logic.

Question 2a
Draw the corresponding activation curve (conductance as a function of membrane voltage) for the conductance shown in the I-V-plot below.

**Question 2b**
Draw the corresponding activation curves for the Na+ and K+ conductance given in the I-V-plot below.
Question 4
Assume you are injecting a depolarizing current step into a neuron. Draw the corresponding membrane voltage time course. Hint: compute time constant first (input resistance $R = 100$ MOhm, capacitance $= 100$ pF). Compare this time-course to the rising phase of an action potential. Explain the difference.

Question 5
What would happen if the activation time constant $\tau_n$ and $\tau_m$ for the gates of the sodium and potassium conductances were the same?

Question 6
How many uncompensated charges are necessary to produce a 100mV change in potential across the membrane of a spherical neuron with a 20 µm radius? If these charges were carried by Na⁺, by what fraction would the number of intracellular Na⁺ ions increase, assuming an initial intracellular concentration of 15 mM Na⁺? [Tip: The capacitance of a neuronal membrane is 1µF/cm² {i.e $10^{-6}$ Coulomb/(V*cm²)}; the Faraday constant is 96485 Coulomb/mol].

Question 7
Explain what is meant by “saltatory conduction”.

Question 8
Describe the voltage clamp method. What is being measured? What is the voltage clamp method used for? When a current is produced by the ion channels, why does the membrane potential not change as it normally would?

**Question 9**
Explain how Hodgkin and Huxley used the voltage clamp method to determine the mechanism behind the action potential regarding Na\(^+\) and K\(^+\) conductances.

**Question 10**
Draw an action potential. Label the axes and the underlying events that are occurring at that point in time. (ie. Discuss the current flow).

**Question 11**
You have a neuron with a resting potential of -55 mV, E\(_{\text{K}}\) of -70 mV, and E\(_{\text{Na}}\) of 50 mV. You decide to voltage clamp the axon. Now, draw the membrane current over time. What will the responses look like? Explain why.

a. Cell depolarized to -10 mV.

b. Cell depolarized to +40 mV.

c. Cell hyperpolarized to -100 mV.

**Question 12**
What is the term “n” in the following equation? \( g_K = g_{K(\text{max})}n^4 \). What two variables affect n? What is the assumption underlying raising n to the 4\(^{\text{th}}\) power?

**Question 13**
The sodium channel has two variables that describe its gating behavior. Explain.

**Question 14**
Why is the squid giant axon so big in diameter? Speculate which behavior could be mediated by this axon.