QUIZ 01 - (one attempt)

Instructions: Download the quiz from Blackboard (in Quiz Questions Folder), print a copy and use the paper copy to work through the various questions and problems. Mark the correct answers on it. When you are ready to **submit** your answers, you will see the quiz posted under Quiz Answer Sheets.

Click the quiz name to launch the quiz. Enter your answers to each of the corresponding numbered questions onto the **blank answer sheet** (the questions will not be repeated, simply a blank page for your answers). The quiz may be saved if you do not finish entering your answers in one sitting. When you are finished with the quiz, make sure to **submit** your answers and they will be recorded.

For each question, select the one **best answer** from among those given (multiple choice). Each question is worth one (1) point.

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1. Which of the following techniques produced unequivocal support for the neuron doctrine which stated that the nervous system was composed of independent cells that were not connected to each other?

   a. Electron microscopy of nervous tissue which revealed a distinct gap between cells at points where synapses made contact.
   b. Demonstration that the knee jerk reflex included both excitation of extensor muscles and inhibition of flexors.
   c. Functional magnetic resonance imaging (fMRI)
   d. EEG (electroencephalogram)
   e. Golgi stain (light microscopy)

?

2. Which organ shows the greatest overrepresention in the sensory cortical homunculus?

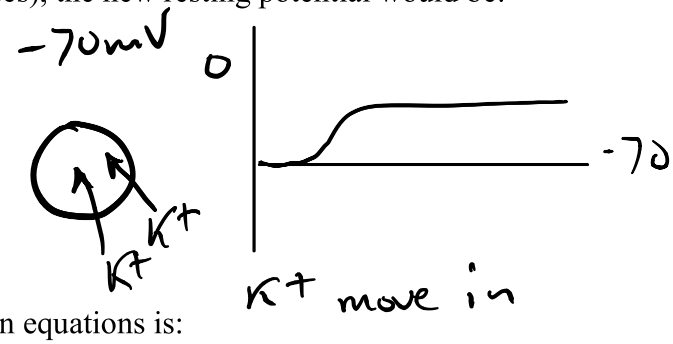
   a. Eyes
   b. Shoulder
   c. Lips
   d. Legs
   e. Feet

3. Suppose all of the sodium and potassium concentrations (both inside and outside a neuron) that were given in class were cut in half, but the permeability of sodium and potassium is unchanged. Then:

   a. The neuron would hyperpolarize after the reductions.
   b. The neuron would keep the same resting potential after the reductions.
   c. It is not possible to know what the neuron would do given the information provided.
   d. The neuron would depolarize after the reductions.

4. We have a neuron with a resting membrane potential of -70 mV, if the concentration of potassium outside the neuron were elevated above normal, while the permeability remains unchanged (as in the case of some diseases), the new resting potential would be:

   a. ~~unchanged.~~
   b. less negative than -70 mV.
   c. ~~more negative than -70 mV.~~
   d. ~~0 mV.~~
   e. ~~positive rather than negative.~~



5. The relationship between the Nernst and Goldman equations is:

   a. The Goldman equation reduces to the Nernst equation when only one ion is permeable.
   b. ~~At both the Goldman and Nernst potentials, current is flowing across the membrane.~~
   c. ~~The Nernst applies to only one permeable and uncharged ion while the Goldman applies to multiple permeable and charged ions.~~ - z in Nernst is charge on ion
   d. ~~The Nernst applies only to potassium, while the Goldman incorporates sodium and chloride as well.~~ - applies to only one ion, not exclusive to potassium

6. The concentration of a positively charged ion is higher outside than inside a neuron. The permeability of the membrane to this ion is near 0 and the initial membrane potential (Vm) is 0 mV. If the permeability to this ion increases drastically, and all other variables remain the same, what will happen to the Vm of the cell?

   $V_{m0} = 0mV$

   a. There is not enough information.
   b. Vm will become negative.
   c. Vm will remain at 0mV.
   d. Vm will become positive.

7. You have an artificial membrane which is permeable just to potassium ions. A more concentrated solution of KCl in water is on one side of the membrane, a more diluted solution is on the other side of the membrane. You observe a stable -80 mV resting potential across the membrane (outside-inside) at 15 degrees Celsius. What will be the resting potential if you warm the solutions to 25 degrees?
   (Hint, Nernst Equation:

$$E = \frac{RT}{zF}\ln\frac{[\text{ion outside cell}]}{[\text{ion inside cell}]} = 2.3026\frac{RT}{zF}\log_{10}\frac{[\text{ion outside cell}]}{[\text{ion inside cell}]}$$

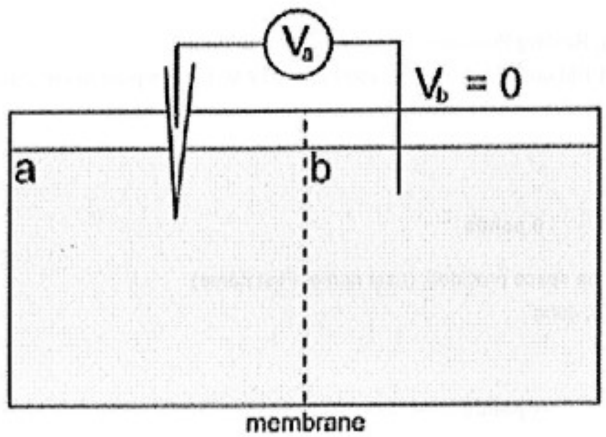
   Universal gas constant: R = 8.314 J·mol^{-1}·K^{-1}
   Conversion of Celsius to Kelvin: x °C = (x+273.15) K
   Faraday Constant: F = 96485.332 C/mol.)

$$\frac{RT}{F}\underbrace{\ln\left(\frac{\quad}{\quad}\right)}_{\text{A constant}} = -\underset{80mV}{.08V} : \frac{R(T+10)}{F}\cdot C = ?$$

$-.08V \cdot \frac{F}{RT} = C$

a. -133.3 mV
b. -83.5 mV
c. -80.0 mV
d. -77.32 mV
e. cannot tell from the information given

8. The solutions in chambers a and b below contain only KCl dissolved in water, but at unknown concentrations. The membrane potential (Va) across the membrane separating the two compartments is stable at -58 mV (Va-Vb). Your high school assistant tells you that he/she has just added more powdered KCl to the right side of the chamber (side B) to increase the concentration of KCl on that side. You look at the potential difference and see that side A is still -58 mV relative to Vb (the reference "zero side"). You checked all your experimental facilities and materials (voltage meter, membrane, etc.) and they are working properly, then, which of the following is most likely to be true?



a. Your assistant is mistaken. KCl was never added.
b. The membrane is not permeable to Cl-.
c. The membrane is equally permeable to both K and Cl.
d. The concentration of chloride on the side b is 10 times higher than that on side a after the addition of the KCl.
e. None of the above are true.

9. Suppose a neuron permeable only to Na+ and K+ ions has a resting potential of -20mV. If the permeability to both of these ions were doubled, what would happen to the resting potential?

a. It would double to -40 mV.
b. It would move to +20 mV.
c. It would move to +58 mV.
d. Nothing, it would stay at -20 mV.
e. We cannot tell what would happen based upon the information provided.

$$58 \log \left[\frac{P_{K^+}[K^+]_o + P_{Na^+}[Na^+]}{P_{K^+}[K^+]_i + P_{Na^+}[Na^+]} \right]$$

double P_K, P_{Na}

Two cancels out

$$58 \log \left[\frac{2P_{K^+}[K^+]_o + 2P_{Na^+}[Na^+]}{2P_{K^+}[K^+]_i + 2P_{Na^+}[Na^+]} \right]$$

10. A neuron has the following external and internal ion concentrations:

Ion	Out	In
A^+ (charge: +1)	10 mM	100 mM
B^+ (charge: +1)	100 mM	10 mM
C^- (charge: -1)	200 mM	10 mM

The neuron has a resting membrane potential more negative than the A+ Nernst potential. Which of the following MUST be FALSE?

Nernst $\Rightarrow 2.306 \frac{RT}{zF} \log \frac{[out]}{[in]} =$

a. The neuron is permeable to A^+ .
b. The neuron is permeable to B^+ .
c. The neuron is permeable to 2 different kinds of ions.
d. The neuron is not permeable to C^-.
e. All of the above are true

Goldman $\Rightarrow 58 \log \left(\frac{P_A [A]_o + P_B [B]_o + P_C [C]_i}{P_A [A]_i + P_B [B]_i + P_C [C]_o} \right)$

Thought questions (ungraded):

11. What kinds of maps are present in the central nervous system? Compare and contrast the maps you find in the spinal cord with those in the brain.

12. Describe, in words, how each term of the Nernst equation affects the equilibrium potential for a given ion across a membrane.