BIO 131 PAL
Week 3 – Problem Set 1

MEMBRANE POTENTIALS

1. A membrane potential of +30 mV is larger than a potential of -70 mV.
   A. True B. False

2. At the peak of an action potential, the electrical potential for K is directed
   A. inward B. outward

3. Lidocaine inactivates voltage-gated Na^+ channels on the neuronal membrane. If lidocaine is placed on the axon of a nerve that normally transmits signals from a pain receptor to the brain (to be interpreted by the brain as "pain"), the pain is not "felt" by the individual. This is because…
   A. There is no longer any action potential sent by the pain receptor to the brain.
   B. There is varied interpretation by pain centers in response to pain.
   C. The action potential sent down the axon has a smaller amplitude than normal, so the brain ignores it.

4. A. If you increase the concentration of K^+ on the outside (hyperkalemia) of the cell from 4 mM to 8 mM, what does this do to the magnitude of the concentration gradient for K^+ (assume the electrical gradient and ICF concentration for K+ stays the same)?

   B. How is the overall cell's resting membrane potential affected when you change the concentration of K^+ on the outside of the cell from 4 mM to 8 mM?

5. A neuronal membrane changes potential from –60 mV to –50 mV.
   A. Using a diagram that you draw, explain what ionic movements could be responsible for the change in potential.
   B. What term do we use to describe this change in polarity?

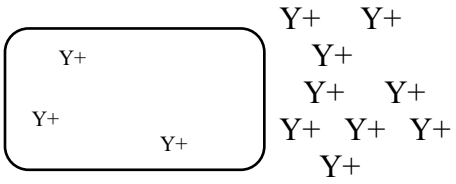
   C. If the membrane instead changed from –60 mV to –65 mV, would the ionic movements be different? Describe what this type of change would be called.

6 . Assume that a membrane that is permeable to Na^+ but not to Cl^- separates two solutions. The concentration of sodium chloride on Side 1 is much higher than on Side 2. Draw this situation in the space below, and then decide which of the following ionic movements will take place. (Circle all correct answers)

A. Na^+ will move until its concentration gradient is dissipated (i.e. until the concentration of Na^+ on Side 2 is the same as the concentration of Na^+ on Side 1)
B. Cl^- will move down its concentration gradient from Side 1 to Side 2.
C. A membrane potential, negative on Side 1, will develop.
D. A membrane potential, positive on Side 1, will develop.

Defend your choice in the space below

6. Answer the following questions for the hypothetical ion Y+:
   A) Which way is the chemical/concentration gradient pointing? How about the electrical gradient, assuming that the resting membrane potential is +65 mV (it's an alien cell)?



   B) If the membrane became permeable to Y+, which way would Y+ move, assuming E_{Y+}= +70mV?

7. The axon hillock of a neuron receives the following PSPs at the same moment: 5 EPSPs of +3 mV each, and 7 IPSPs of –1 mV each.

A. If the resting potential of the neuron is –60 mV, what will be the new potential at the axon hillock?

B. If the threshold level for starting an action potential is –52 mV, will the neuron reach threshold?