Molecular Cell Biology 5068 In Class Exam 2 **Exam Number: _____**
November 4, 2014

Please print your name: _____

Instructions:

Please write only on these pages, in the spaces allotted and not on the back. Write your number on each page (not your name), so that we can split them up and grade them anonymously. There are a total of 6 pages including this cover page. You may not use any books or notes, and no electronic aids, including calculators.

Answer only in the space provided; short, concise answers are preferred and will be rewarded. Please be as neat as possible.

When you are finished, turn this in to the TA and pick up the take-home portion.

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Mercer Section (16 points total)

1. In the lecture, Dr. Mercer discussed the monarch butterfly, which concentrates digitalis in its larvae. Thus, any insect/animal that eats the larvae of this butterfly will die/get sick because of digitalis. What does digitalis block, and what is the function of the target protein blocked by digitalis? (3 Points)

2. Name three functions of tight junctions. (3 Points)

3. (True or False) Paracellular flux is a selective barrier that can be "leaky". (1 Point)

4. (True or False) The primary protein responsible for the permeability properties of the tight junction is occludin. (1 Point)

5. (True or False) A mutation in claudin-16 causes hypermagnesium. (1 Point)

6. Connexons are "gated" transmembrane protein complexes. If a neighboring epithelial cell is dying and its cell membrane becomes leaky, the connexons in the adjacent cell will close as a protective mechanism. Specifically, what ion does the connexon sense to cause closure? (1 Point)

7. Briefly describe how aquaporins (water channels) in the renal collecting duct respond to Antidiuretic hormone (ADH) to maintain water homeostasis. (4 Points)

8. Name 1 basal-lateral sorting signal (1 Point).

9. Name 1 apical sorting signal (1 Point).

Colin Nichols Section (22 points)

1. Briefly describe how K^+ channels are selective to K^+ but not to Na^+. (3 Points)

2. Circle the right word for each of the four sentences (4 Points):

Concentration of sodium is higher on [inside/outside] the cell.

Concentration of potassium is higher on [inside/outside] the cell.

Concentration of chlorine is higher on [inside/outside] the cell.

Resting membrane potential of a neuronal cell is [negative/positive].

3. Explain two differences between Goldman-Hodgkin-Katz Equation and Nernst Equation. Be sure to explain (1) what does the numerical value from each equation represent, and (2) what additional parameter is accounted for in one equation but not in another. (4 Points)

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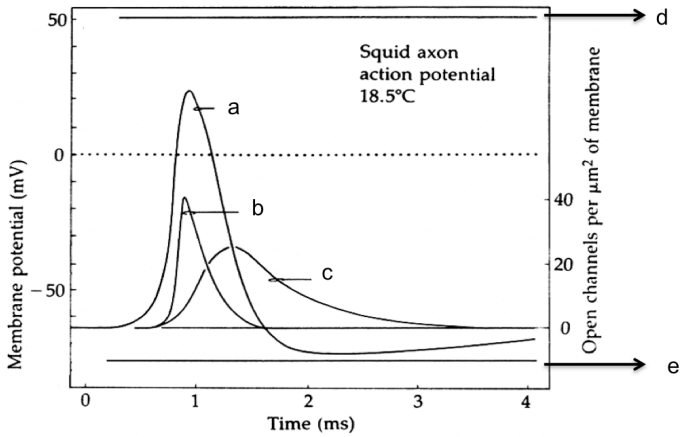
4. (True or False) During electrochemical equilibrium, there is no requirement for any energy-driven pump to maintain the concentration gradient while in steady-state condition, the cell must supply energy to maintain its ionic gradients. (1 Point)

5. (True or False) During electrochemical equilibrium, there is net flux of individual ions but no charge movement while there is no net flux of the ion in steady-state condition. (1 Point)

6. Label what a, b, c, d, and e represent on the graph below: (5 Points)

Currents During an Action Potential



Time Course of Currents

7. Draw a cartoon and give a short description to illustrate the gating states of the Na^+ channel states during all phases of an action potential. (4 points)

Ron Bose Section (22 Points)

1. Describe three main procedural steps taken to produce a spectrum using a mass spectrometer, starting with an adequately pure protein sample. (3 Points)

2. Determine how metabolic labeling ("SILAC") with mass spectrometry works for protein quantification. Discuss the steps needed to prepare samples to use on mass spectrometry (3 Points).

3. Explain how iTRAQ, a form of chemical labeling, differs from metabolic labeling techniques. (3 Points).

4. Herceptin is an example of _____ antibody that targets extracellular domain of Her2. (1 Point)

5. Explain two early experiments that demonstrated the role of Her2 in breast cancer. (4 points)

6. Explain how ATRA (all-trans retinoic acid) works to treat patients who have acute promyelocytic leukemia (APL). (4 Points)

7. Beta blockers are used to control heart rate and blood pressure. What family of G-protein coupled receptors do these compounds target? (2 points)

8. Patients with Chronic kidney disease are given recombinant Erythropoietin (EPO) to prevent anemia. What family of receptors does EPO bind to? (2 points)

Blumer Section [30 points]

1. List the four modes of cellular communication (4 Points).

2. List the 3 established models for signal transmission from one molecule to another. (3 Points)

3. Describe the standard biochemical experimental approach to determine the specific binding curve for a ligand such as insulin binding to its cellular receptor, given that the ligand undergoes both specific and non-specific binding to the cell surface. (3 Points)

4. List 3 second messengers that mediate cellular signal transduction. Describe an example of downstream signaling mediated by one of the molecules you listed, as discussed in lecture. (4 Points)

5. [True or False] G protein coupled receptors (GPCRs) are typically single-pass transmembrane proteins while cytokine receptors typically have a conserved 7 transmembrane domain architecture. (1 Point)

6. Briefly explain why the RhoGAPS outnumber the small GTPases Rho/Rac/Cdc42 by nearly 5-fold? (1 Point)

7. Describe two mechanisms of GPCR desensitization used to attenuate signal transduction. (2 Points)

8. For small GTPases, describe the mutation and effect on cellular signaling associated with a dominant negative mutant protein. (2 Points)

9. List 3 mechanisms by which small GTPases can be turned on. (3 Points)

10. Fully describe the mechanism by which EGFR signaling activates Ras. Make sure to mention all the components involved. (5 Points)

11. Why is PTEN more prone to mutations in human cancers than the RTK and PI3K phosphatases? (2 Points)

Bose Signaling Questions [10 points]

1. What cellular function is the key regulatory target of the mTORC1 signal integrator? (1 Point)

2. List the 3 major categories of the Nuclear hormone receptor superfamily (3 Points)

3. List the two major mechanisms of protein kinase regulation. Give an example of a protein kinase that is regulated by each of the mechanisms you listed. (4 Points)

4. What is the function of the DFG motif at the N-terminus of the Protein Kinase A activation loop? (1 Point)

5. What is the role of PI3K in the AKT signaling pathway? (1 Point)