Molecular Cell Biology 5068 In Class Exam 2 **Exam Number: _____**
November 8, 2016

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.

Exam Number:_____

MCB 5068 Exam 2 November 8, 2016 (120 points possible)

Mercer Section (25 points total)

1. List four diseases associated with membrane transport defects. (4 points)

2. The Na,K-ATPase transports _____ (number of ions) Na^+ (in/out) and _____ (number of ions) K^+ (in/out) of the cell upon the hydrolysis of _____ (number of molecules) ATP. A specific inhibitor of the Na,K-ATPase is: _____. (3 points)

3. List and describe the three types of protein carrier-mediated transport. Compare and contrast primary and secondary active transport. What are the two different means of facilitated diffusion? (3 points)

4. Tight junctions create a seal at the apical surface between epithelial cells. Name two types of proteins found in tight junctions and describe their number of transmembrane spanning domains. (4 points)

5. Anchoring junctions utilize intracellular cytoskeletal attachments to join neighboring cells. Name two types of these junctions and the cytoskeletal filament type that is incorporated. (4 points)

6. Name the three routing pathways that epithelial cells use for sorting newly synthesized proteins to the plasma membrane. (3 points)

7. ADH is a hormone that regulates the retention of water by acting to increase water reabsorption in the kidney's collecting ducts. Name the protein that mediates the uptake of water in response to ADH. (1 point)

8. (True or false) With regard to plasma membrane adherens junction proteins, E-Cadherin binding is Ca^{2+}-dependent while Nectin binding is Ca^{2+}-independent. (1 point)

9. (True or false) The Na,K-ATPase pump is generally located exclusively on the basolateral membrane of mammalian cells. (1 point)

10. (True or false) Hemidesmosomes mediate cell-to-matrix binding at the basal surface of epithelial cells. (1 point)

Exam Number:_____

Colin Nichols Section (20 points)

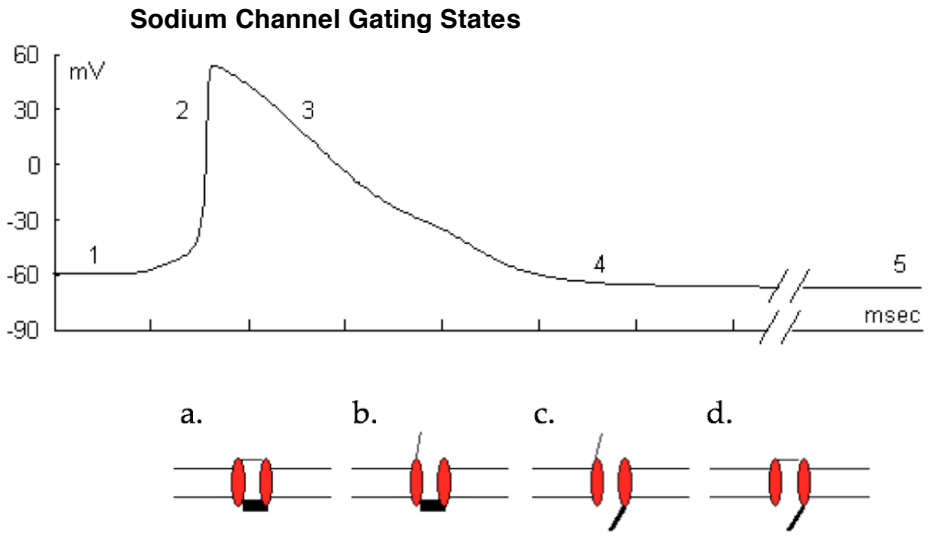
1. Briefly describe how selectivity is achieved in the typical K^+ channel protein (2 points).

2. Identify two differences between the Nernst equation and the Goldman, Hodgkin, Katz (GHK) equation. Why does the GHK equation provide a better description of membrane potential as a function of potassium concentration in cells? (3 points)

3. Please fill in the following table with the term "higher", "lower" or "equal" (4 points).

	Extracellular concentration	Intracellular concentration
Na^+		
K^+		
Cl^-		
Free Ca^{2+}		

4. Write the correct sodium gating states next to their corresponding numbers on the graph (you may reuse the same letter): (5 points)



5. K_{ATP} channel mutations may lead to serious diseases in infants. This is due to the central role of K_{ATP} channels in controlling which hormone? Name one disease that was mentioned in class and describe its mechanism of action. (3 points)

6. (True or false) The acetylcholine receptor is a selective cation channel that is only permeable to Na^+. (1 point)

7. (True or false) Only excitable cells exhibit passive changes in membrane potential when stimulated. (1 point)

8. (True or false) The final effect of an action potential is to elevate intracellular calcium. (1 point)

Ron Bose Signal Transduction Section (20 Points)

1. What are the three major categories of nuclear hormone receptors (NHRs)? List one example of each. (6 points)

2. Describe the main functional domains of NHRs. (2 points)

3. What are the four genes in humans and mice associated with JAKs? (2 points) What important binding motif is present in all the JAKs (1 point)?

4. What is the role of mTOR signaling? What proteins are common to both mTOR complexes? Which are specific for each? What is the other major difference between the two complexes? (5 points)

5. In regards to MAP kinase, describe the transition from the inactive to the active conformation. What modification is present on what residues, and how does this change the overall structure? This is an example of what major mode of signal transmission? (4 points)

Ken Blumer Section (36 points)

1. List and describe the four modes of cell communication. (4 points)

2. List and describe the four classes of cell surface receptors. (4 points)

3. Phospholipase C-ß reacts with a membrane bound substrate to create two second messengers. What is this substrate, what are the two second messengers and what proteins, respectively, to they directly influence? (5 points)

4. Briefly describe the cycle by which calmodulin regulates the activity of CaM-kinase II. (2 points)

5. How are Receptor Tyrosine Kinases (RTKs) activated? Specifically mention the modification, the structure it affects, and the structural changes that occur. (4 points)

6. Briefly describe EGFR activation of Ras. Be sure to mention all proteins, modifications, binding motifs and basic modes of signal transmission involved at each step. (5 points)

7. Which major type of signaling pathway discussed in class exhibits switch-like behavior? How is this accomplished? (2 points)

8. Briefly describe the interaction between PIP3 and PKB (Akt). Be sure to mention all proteins, modifications, binding motifs and basic modes of signal transmission involved at each step. (5 points)

9. PTEN is often deleted or mutated in cancers. What pathway does PTEN act on? Explain how a PTEN deletion would contribute to a cancer phenotype. (2 points)

10. Draw the cellular phenotypes associated with Alan Hall's 1998 experiments involving the Rho GTPase family. List the three members of the family, and each phenotype associated with them. (3 points)

Stephen Oh Section (11 points)

1. What was the first recurrent chromosomal abnormality associated with cancer and how does it occur? What fusion protein is this anomaly associated with and what is its function? What is the name of the drug that inhibits this fusion protein, how does it work? (5 points)

2. List the three other myeloproliferative neoplasms (MPNs) that do not involve the fusion protein involved in the above question. (3 points)

3. List 3 signaling processes that are aberrant in MPNs. (3 points)

Ron Bose Proteomics and MS (8 points)

1. Describe how a DIGE experiment works. What are 2 limitations of this method? (4 points)

2. The following peptide is digested to completion with trypsin:

   (NH3)-T-H-R-A-E-P-T-K-R-Q-E-(COOH)

   List the fragments produced. (2 points)

3. (True or false) The Y-ion contains the *N*-terminus. (1 point)

4. (True or false) ^{14}C and ^{15}N are useful isotopes used in mass spectrometry. (1 point)