Molecular Cell Biology 5068 Exam 1
October 3, 2017

Exam Number: ____________

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.

_____________________________________________________________________

Comments:
1. What are the 4 types of phospholipid movement? Which one occurs least often and why? (5 points)

2. What is the rate-limiting step in cholesterol biosynthesis? (1 point)

3. Name the three basic categories of membrane proteins. (3 points)

4. Explain the difference between the scramblase and flippase enzymes based upon the membranes with which they are associated, the symmetry of these membranes, and their energy requirements. (5 points)
5. What enzyme catalyzes the formation of disulfide bonds and where does this occur? (2 points)

6. Describe one of the three routes a protein may travel in order to be inserted into the inner membrane of the mitochondria. Make sure to mention all the components necessary. (3 points)

7. What are two ways that lipids may be transferred between different intracellular compartments? (2 points)

8. Name 3 properties of the secretory signal sequence. (3 points)

9. Name two ways that protein mobility is restricted in biological membranes. (2 points)
Dr. Hanson’s Lectures (34 Points)

1. How is folding facilitated and monitored by classical chaperones? (2 points)

2. When a newly synthesized glycoprotein in the ER fails its first attempt to fold, “nearly folded” proteins will enter the Calnexin/Calreticulin cycle. What roles do re-glucosylation, de-glucosylation, and de-mannosylation play in terms of guiding proteins through folding intermediates? (3 points)

3. Describe the process of UPR in yeast from beginning to end. Be sure to discuss the roles and interactions of Ire1, BiP, Hac1, and UPRE in your answer. (4 points)
4. Answer either A or B. (3 points)
A. Describe how t-SNARES and v-SNARES form the mechanism of membrane fusion. What protein is responsible for the disassembly of SNARE complexes after fusion is complete?

B. Explain how LDL, transferrin, and EGF differ regarding what happens to the receptor and cargo.

5. List the 5 proteins that operate as minimal COPII machinery and briefly describe their functions. (5 points)
6. List four routes by which extracellular components can be internalized into cells. Explain one feature that is unique to each process. (4 points)

7. T / F (Correct if false) Rab5 is a marker for early endosomes, and Rab7 is a marker for late endosomes. (2 points)

8. T / F (Correct if false) The KDEL peptide binds the KDEL receptor at low pH in the cis-Golgi and releases at high pH in the rough ER. (2 points)
9. Patients with I-cell disease have lysosomal enzymes that lack a M6Pr tag. What is the critical role of M6P for lysosomal function? (1 point)

10. Describe the set up and steps of the experiment that delineated the secretory pathway in *Saccharomyces cerevisiae* using sec mutants. Choose two different defective functions and identify where the secreted proteins accumulated due to the defects. (7 points)
Drs. Greenberg, Mahjoub, Morley, Weihl Lectures (40 Points)

1. Fill in the following table. (6 points)

<table>
<thead>
<tr>
<th>Subunit</th>
<th>Charged ends (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microtubules</td>
<td></td>
</tr>
<tr>
<td>Actin</td>
<td></td>
</tr>
<tr>
<td>Intermediate filaments</td>
<td></td>
</tr>
</tbody>
</table>

2. Select three microtubule binding proteins from the list below, describe what they do and give an example. (6 points)
   a. Nucleators
   b. Stabilizers
   c. Destabilizers
   d. Severers
   e. Bundlers
   f. Chaperones

3. How are heterogeneity and specificity of microtubule function regulated? (4 points).
4. Fun Matching (4 points):

____ Binds to barbed end of F-actin and prevents the addition of monomers
  A. Gelsolin
  B. Cofilin
  C. Arp 2/3
  D. Capping protein

____ Severs F-actin and caps barbed end

____ Binds to the side of F-actin and generates novel filaments in branching pattern

____ When bound to F-actin, promotes ATP -> ADP hydrolysis.
    When bound to G-actin, inhibits ADP -> ATP exchange

5. List 3 in vivo functions of intermediate filaments. (3 points)

6. The below image is of the polymerization of actin. Label each of the steps. Then, draw in the kinetics of this process and also label the corresponding steps. (7 points)

![Image of actin polymerization]

1. _______
2. _______
3. _______

![Graph of filament mass over time]
7. What are two consequences of impaired protein degradation? (2 points)

8. The ubiquitination of proteins occurs in a four-step process. Describe each individual step in no more than 2 concise sentences. Be sure to mention important enzymes that are involved in each step and if ATP is hydrolyzed. (4 points)

9. Circle the correct word:

Rapamycin is an (inhibitor / inducer) of autophagy. It does this by (inhibiting / activating) the mTOR pathway. When mTOR is (inactive / active), this leads to protein synthesis and cell growth. When mTOR is (inactive / active), this leads to the inhibition of protein synthesis and increased autophagic degradation of protein. (4 points)