BIOL 4374/BCHS 4313
Cell Biology
Exam #2
October 30, 2002

SS#_____ Name_____

This exam is worth a total of 100 points. The number of points each question is worth is shown in parentheses. Good luck!

1. (3) A protein encoded by a nuclear gene has two N-terminal mitochondrial targeting sequences that are ultimately removed from the protein. In which mitochondrial compartment will this protein reside? Explain your answer.

   The first signal sequence will bring the protein through both outer and inner membranes to the lumen. The second signal sequence will bring the protein back through the inner membrane into the intermembrane space.

2. (2) Which characteristics describe a protein encoded by a nuclear gene that ultimately resides in the chloroplast stroma? answer - d
   a) Has an N-terminal signal sequence that binds to SRP
   b) Requires a pH gradient to enter as a folded protein
   c) Translated in the cytoplasm and has a C-terminal SKL sequence
   d) Translated in the cytoplasm and enters as an unfolded protein
   e) Crosses the inner and outer membranes simultaneously as a folded protein

3. (4) Describe the mechanism by which a nuclear protein is recognized and transported into the nucleus.

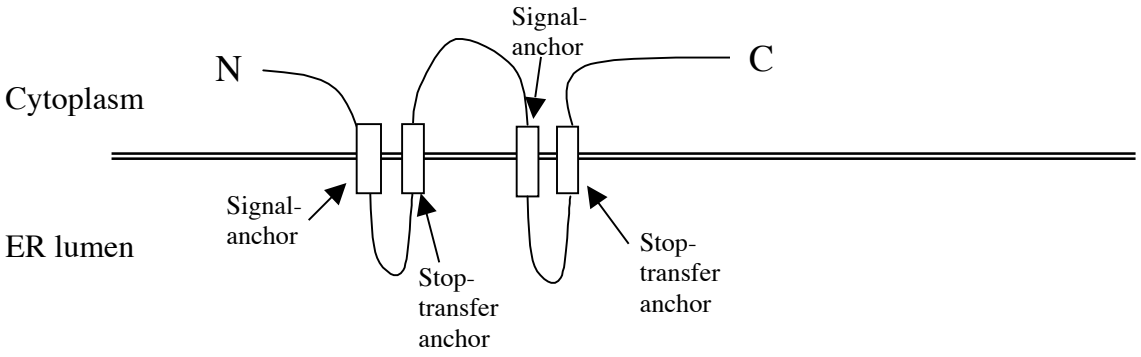
   1) The protein has a nuclear localization sequence of >5 basic amino acids or two groups of 3 basic amino acids spaced <10 amino acids apart.
   2) The nuclear localization sequence is bound by importins in the cytoplasm.
   3) Importins □ and □ carry the protein into the nucleus through the nuclear pore.
   4) Ran-GTP binds to importin □ to release the protein in the nucleus.

4. (5) During translation of a secreted protein, SRP binds to the ___signal sequence_____, stops translation, and brings the ribosome to the __SRP receptor_____ on the ER membrane. Translation then resumes, __signal peptidase_____ cleaves the signal sequence, and the protein moves through the ___translocon_____ into the ____lumen_____ of the ER.

5. (5) Match the organelle with its appropriate targeting sequence.

__c_____	Lysosome	a) C-terminal SKL
__d_____	ER	b) Stretch of at least five basic amino acids
__a_____	Peroxysome	c) Mannose-6-phosphate
__e_____	Golgi	d) KDEL sequence
__b_____	Nucleus	e) Transmembrane domain

6. (4) A protein consists of the following topogenic features: an internal signal-anchor sequence, a stop-transfer anchor sequence, a signal-anchor sequence and a stop-transfer anchor sequence arranged sequentially, N to C, and separated by various hydrophilic amino acids. Draw how this protein would orient in the membrane making sure to define the cytosolic and luminal sides of the membrane and where the N and C terminus of the protein will be.



7. (2) In the cytosol, the reduced form of _glutathione_____ blocks disulfide bond formation.

8. (5) Describe the sequence of events by which an excess of unfolded proteins lead to the production of proteins needed for protein folding. Be sure to mention at least two specific examples of proteins whose production is induced in this way.

1) Unfolded proteins in the ER lumen activate the IRE1 kinase
2) IRE1 kinase promotes the splicing of HAC1 mRNA
3) HAC1 protein activates transcription of the following folding factors:
4) Hsc70
5) Calreticulin/calnexin
6) Peptide prolyl isomerase
7) PDI

9. (3) Oligosaccharide-protein transferase transfers an oligosaccharide comprised of __9___ mannose, ___2__ acetyl-glucosamine and ___3___ glucose residues from dolichol to asparagine.

10. (4) Chromogranin B and secretogranin II are found in the ___trans Golgi_____ (cellular compartment), and will form aggregates with proteins destined for __regulated____ secretion.

11. (4) O-linked glycosylation occurs at ___serine_____ and ___threonine_____ residues.

12. (2) GPI anchors target proteins to: answer - b
    1) Lysosomes
    2) Apical membranes
    3) The ER
    4) Basolateral membranes
    5) Trans Golgi

13. (2) At pH 5.0, transferrin releases: answer - a
    a) Iron
    b) Transferrin receptor
    c) Clathrin
    d) Cholesterol
    e) Antibodies

14. (5) Match the statement that best describes the molecule at the left.

__f_____	Clathrin	a) Mediate vesicle fusion
__c_____	V-SNARE	b) Mediate transport from cis Golgi to ER
__b_____	COPI	c) Vesicle targeting protein
__d_____	COPII	d) Mediate transport from ER to cis Golgi
__a_____	SNAP25/NSF	f) Mediate endocytosis

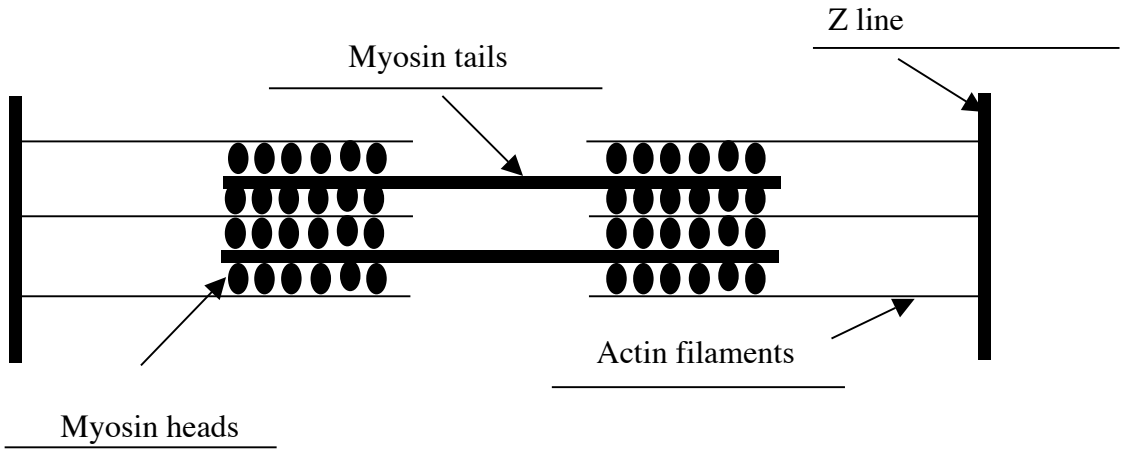
15. (3) What will happen to the + and – ends of actin filaments if the G-actin concentration is <Cc+ and >Cc-? Could this ever happen in a cell? (Explain your answer)

    Polymerization will occur at the – end, but will not occur at the + end. No this should not occur in a cell because Cc+ is much lower than Cc-.

16. (4) Name the two basic types of structures that actin can form.
    1) bundles
    2) networks

17. (4) Inside the cell, the actin binding protein Thymosin β4 __inhibits___ actin assembly and profilin ___promotes___ actin assembly.

18. (4) Label the sarcomere from a skeletal muscle depicted below.



19. (4) Describe the four steps by which ATP controls the movement of myosin along an actin filament.

    1) ATP binds to the myosin head which causes release of the actin filament
    2) ATP hydrolysis causes the head to pivot and bind actin further in the + direction
    3) Release of phosphate causes movement by pivoting the head to its original position
    4) Release of ADP enables the next round of movement to occur

20. (2) Which molecule caps the + end of actin filaments in the sarcomere?
    a) Nebulin
    b) Titin
    c) Tropomodulin
    d) CapZ
    e) Myosin

    answer - d

21. (3) In smooth muscles, contraction occurs when __calcium_____ ions bind to caldesmon, which alters the conformation of ___tropomyosin____, thereby revealing the myosin binding sites on ___actin filaments_____.

22. (2) In a tubulin dimer, only ___beta____ tubulin can hydrolyze GTP.

23. (4) Name two components of the centrosome that promote MT growth.
    1) centrioles
    2) gamma tubulin

24. (4) Cargo moving anterograde along microtubules uses __kinesin_____ as the motor protein, while cargo moving retrograde along microtubules uses __dynein_____ as the motor protein.

25. (4) Flagella grow from MTOCs called __basal bodies_____. When ATP is available, ___dynein_____ (motor protein) mediates sliding of the outer doublets of microtubules to produce bending.

26. (4) Microtubules start to shrink when they lose their __GTP__ cap at the ___+___ end.

27. (3) Chromosome segregation is mediated by the disassembly of ___kinetochore_____ MTs, whereas separation of spindle poles is caused by the + end directed movement of ____kinesin/KRPs_____ on polar MTs and the – end directed movement of ____dynein_____ on astral MTs.

28. (5) Match the characteristics with the appropriate cytoskeletal element.

___b____ Does not bind to GTP or ATP

___b____ Has no polarity

___b____ Comprised of many different proteins

___b____ Are very stable

___b____ Play no role in motility

a) Microtubules

b) Intermediate filaments

c) Microfilaments