MCB110
FINAL

Dec 13, 2005

______________________________________.
Your name and student ID

QUESTION	POINTS
1 (25 points)	
2 (10 points)	
3 (15 points)	
4 (10 points)	
5 (20 points)	
6 (20 points)	
7 (15 points)	
8 (20 points)	
9 (25 points)	
10 (40 points)	
11 (30 points)	
12 (20 points)	
13 (14 points)	
14 (21 points)	
15 (9 points)	
16 (6 points)	

TOTAL (300 points)

WARNING: Your exam will be taken apart and each question graded separately. Therefore, if you do not put your name and ID# on every page or if you write an answer for one question on the backside of a page for a different question you are in danger of irreversibly LOSING POINTS!

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Constants that you may need in the exam: R = 0.025 kcal/(mol . degree centigrade); N_A = 6.02 10^{23} mol^{-1}; F = 23.06 kcal/mol.V

1. – Indicate true of false for the following statements (25 points, 5 each):

(a) Lipids rafts are regions in biological membrane where the fluidity of lipids is reduced
(b) Lipids rafts are enriched in sphingolipids
(c) Lipids rafts are enriched in cholesterol
(d) Lipids rafts are enriched in GPI-anchored proteins
(e) Lipids rafts diffuse on the lipid bilayer

2. - Which are the two main protein folds for the transmembrane region of integral membrane proteins? (5 points) Which one of them can be predicted from hydropathy plots and why? (5 points)

3. – You are studying a protein that resides in the smooth ER and have created a GFP fusion to visualize it by fluorescence microscopy in living cells. What technique will you use to determine if the protein is able to diffuse in the membrane of the ER? (5 points) What results would you expect if the protein were fully mobile or unable to diffuse at all? (10 points).

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4. – The concentration of Cl^- ions in and out of a cell is 10 and 100 mM, respectively (maintained by an ATPase pump). In which direction will Cl^- ions move when Cl^- channels open? Show how you came to that conclusion (15 points).

5. – Indicated YES or NO in the grid below (16 points). You can make small clarifying comments if you think they are necessary.

Property	**Channel**	**Facilitative Transporter**	**Active ATPase Transporter**	**Cotransporter**
Movement down a concentration gradient				
Conformational change accompanying transport				
Requires ATP				
Requires a preexisting gradient				

Why do you think that transport through a channel is faster than through a facilitative transporter? (4 points)

6.- Define the role of SRP in cotranslational translocation. In your answer refer to what it recognizes, how it affects translation, and what role GTP has in targeting (20 points).

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7. – Deduce the cytosolic or extra cellular location of the N- and C-terminus for the following integral membrane proteins (draw it schematically) (15 points) :

Example: A protein with a signal sequence and a single transmembrane segment?
N-terminus – Extra cellular
C-terminus – Cytosolic

a) A protein with a signal sequence and two transmembrane segments?

b) A protein with an internal signal-anchor sequence (far from the N-terminus) (SAII)?

c) A protein with an SAII and one internal stop-transfer anchor sequence (STA)?

8.- Describe the function of GEFs and GAPs in G-protein activity (10 points). Can you think of the GEF for the α subunit of trimeric G proteins? And for the small G protein Ras? (10 points)

9.- What signaling events are needed for the activation of protein kinase C? (15 points)

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10. – Indicate whether or not the following mutations will result in an overproliferative phenotype in the cell. Explain your answer (40 points):

a) A mutation in growth hormone RTK that results in constitutive dimerization and kinase activity

b) A mutation that inhibits nucleotide exchange in Ras

c) A mutation that inhibits GTP hydrolysis in Ras

d) A mutation that inhibits the interaction of Ras with Raf

Question 11 (30 pts)

(a) Explain how an increase in the level of $\sigma 32$ proteins in E. coli cells can lead to the induction of heat shock-responsive genes (14 pts).

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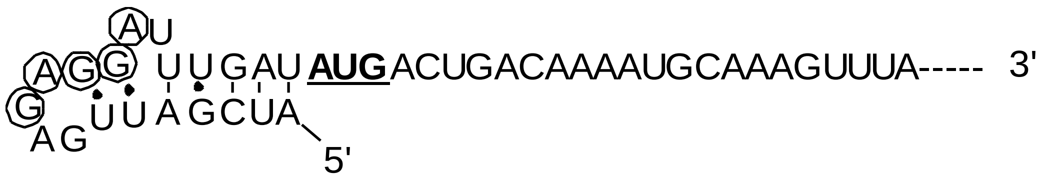
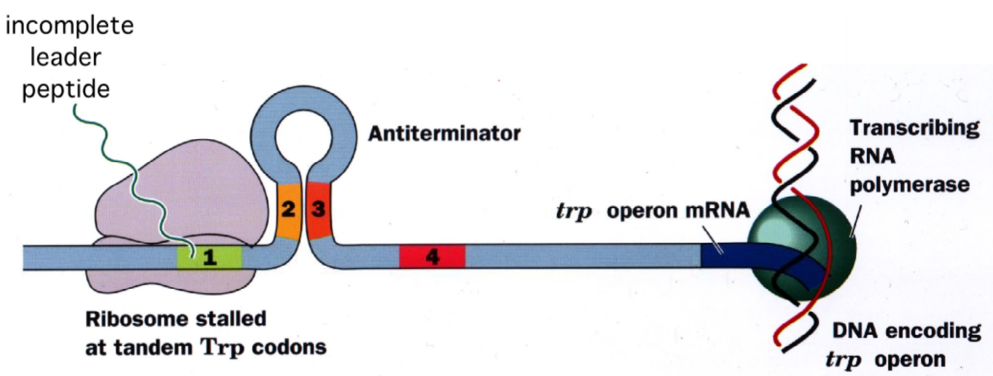
(b) Recent data suggest that the σ32 mRNA contains a built-in thermosensor at its 5' end. The predicted secondary structure of the 5' end of the σ32 mRNA is shown below with the initiation codon underlined and the Shine-Delgarno sequence as letters in small circles. Explain how the σ32 thermosensor may function to increase the σ32 protein level in response to heat shock (16 pts).



Question 12 (20 pts)

When cellular tryptophan levels are low, the leader mRNA of the trp operon, which contains 4 segments, adopts a conformation shown below.



a) How does the availability of tryptophan affect the attenuation process of the trp operon? (10 points)

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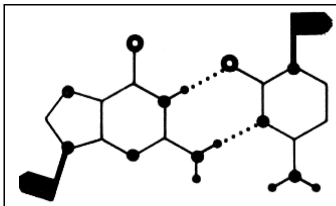
b) Part of the RNA sequence in segment 4 reads: 5'-CGGGC-3'. Based on what you have known about the regulation of the trp operon, please predict a 5-nucleotide sequence that can be found in segments 2 and 3. (10 points)

13A. (4 pts.) The figure below shows a G-C base pair observed in the crystal structure of yeast Phe tRNA. The flags represent the backbone orientations. List two ways that this base pair differs from a standard "Watson-Crick" base pair.



$G_{15}-C_{48}$

13B. (4 pts.) What is meant by the term "coaxial stacking" to describe a common feature of RNA 3-dimensional structure.

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13C. (6 pts.) Not counting coaxial stacking or simple base pairing in stems, list three common RNA structural motifs that introduce or increase stacking interactions.

14A. (12 pts.) List three different enzymes that create RNA:DNA hybrids. For each enzyme, indicate whether the reaction creates the DNA or the RNA polymer.

14B. (9 pts.) Briefly discuss what special features of RNA:DNA hybrids are exploited for each of these three functions In other words, why are these functions not carried out by double-stranded DNA or double-stranded RNA?

15. (9 pts.) Briefly outline an experimental method you would use to find all the homologs of Your Favorite Gene expressed in the human brain?

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16. (6 pts.) Over a third of the human genome is made up of LINEs and SINEs. What is the difference between a LINE and a SINE?