MCB110
Third Midterm

May 10, 2010

_____.
Your name and student ID

QUESTION	POINTS
1 (15 points)	
2 (15 points)	
3 (15 points)	
4 (20 points)	
5 (15 points)	
6 (15 points)	
7 (15 points)	
8 (25 points)	
9 (20 points)	
10 (20 points)	
11 (25 points)	

TOTAL (200 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 LOOSING POINTS!

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Q1 – What is a liposome? (5 pts) Describe one biochemical application (5 pts) and one medical application (5 pts), explaining, briefly but clearly, the benefits of using such system.

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Q2 – What is a lipid raft? Describe its essential physical property (5 pts). What types of lipids are present in rafts? (5 pts) What physiological role do they play in cells? (5 pts)

Q3 – Why are integral membrane proteins difficult to study biochemically? Three reasons, explained, to get full credit (15 pts)

Q4 – A new unicellular organism has been discovered on the surface of Mars. The resting potential of its plasma membrane is defined by Ca^{2+} leaking channels, rather than K+. The calcium concentration is kept 10^3 times lower inside the cell than outside by means of a calcium ATPase pump. What is the resting electric potential across the plasma membrane of this organism? (Hint: because of the leaking channels, calcium is at equilibrium; no other ions are) (20 pts)

$$\otimes G = 2.3RT \log 10 \, [Ci] / [Co] + zF \otimes E$$

At equilibrium $\otimes G = 0$

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$2.3RT\log 10\ [Ci\ ] / [Co] = -zF\otimes E$

$2.3RT\log 10\ 10^{-3} = -zF\otimes E$

$2.3RT\ (-3) = -zF\otimes E$

$1.4\ \text{kcal/mol}\ (-3) = -2 \times 23.06\otimes E$

$\otimes E = 4.2/46.12 = 0.091\ V$ *or* ***91 mV***

(or they can say ~ 100 mV if they do not have calculators for the last step. It is important that they get the sign right!! It is positive as opposed to the negative value in our cells with K leaking channels.

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Q5 – What is the function of the Na/K ATPase and why is it important physiologically for the cell? (5 pts) Describe the steps taking place during a cycle of ATP hydrolysis, concentrating on protein conformation and ion affinities, and their consequences (10 pts)

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Q6 – How does the Na-glucose cotransporter make use of preexisting ion gradients? (5 pts) Place this cotransporter in the physiological context of the brush border cells of the small intestine: where is it present, what other transporters/ATPases are required for the proper functioning of these cells to provide glucose to the blood stream following digestion, and overall flow of glucose. (10 pts)

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Q7 – What is the unique property of voltage gated channels that makes action potentials move unidirectionally? (5 pts) What molecular element is responsible for this property (3 pts) and how was it tested experimentally (7 pts)?

Q8 – What is function of the SRP in the secretory pathway? (5 pts) What are the roles of GTP binding and GTP hydrolysis in the recruitment of active ribosomes to the ER for cotranslational translocation, and what triggers each one of them? (20 pts)

Q9 – For the cellular functioning of coated vesicles, indicate in one or two short sentences what is the role of:

a) the cargo receptors (5 pts)

b) the GTPase (5 pts)

c) the self-assembling coat proteins (5 pts)

d) the v-snare protein (5 pts)

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Q10 – What are the respective roles of GAP and GEF proteins in the regulation of G proteins and their roles in signaling pathways (10 pts)? What are the roles of adaptor proteins in signaling events? Give an example of an adaptor in the activation of the MAP kinase cascade by EGF (10)

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Q11 – Explain, in one or two sentences, how each of these essential steps in signaling are achieved in the case of the glucagon signaling in liver cells that results in glycogen breakdown:

- Initiation of the signaling process (5 pts)

- Activation of an effector (enzyme) protein that generates a secondary messenger (5 pts)

- Amplification of the signal (5 pts)

- Shutdown of the signaling upon disappearance of glucagon (hint: consider all steps along the pathway in your answer)(10 pts)