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1. Membrane transport.

A. (4 pts) What ion couples primary and secondary active transport in animal cells? What ion serves the same function in plant cells?

2. (4 pts) What is the terminal electron acceptor in respiration? In photosynthesis?

3. (5pts) You are an arctic biologist and discover an archeabacterium that lives and reproduces quite well at –10°C. Surprisingly, there is a closely related species that lives in the tropics. When you examine the membranes of the two species you find that the fatty acids are very different.

State two differences you would expect to find in fatty acids of the two species (be sure to indicate which species has which trait).

4. True or false: (7 pts)

_____ Using a scanning electron microscopy, cell biologists can directly observe the surface topology of living cells.

_____ Secretory and membrane proteins are made in the smooth endoplasmic reticulum.

_____ The inside (lumen) of a plant vacuole is positively charged and acidic relative to the cytoplasm.

_____ The cell wall of plants prevents the cells from exploding due to turgor pressure.

_____ Cholesterol broadens the transition temperature of membranes.

_____ A typical cell membrane contains a variety of lipids, proteins and carbohydrates.

g_____ In the helical regions of a transmembrane protein, the hydrophobic side chains on the amino acids are arranged in such a way as to face the water environment

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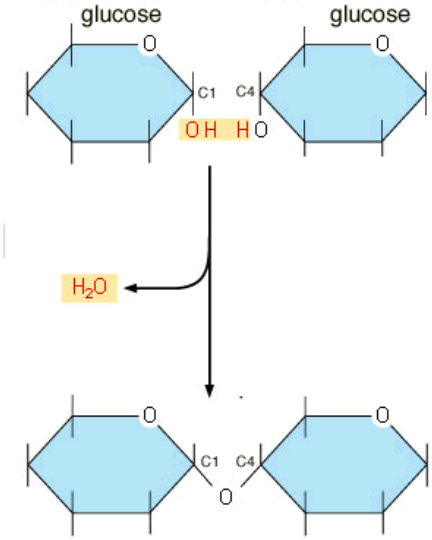
5. Consult the figure shown below:



A. (1pt) What is the general type of reaction shown?

B. (1pt) What sign is the ΔG for this reaction (+ or -)?

C. (2pt) Name the bond formed, being as specific as possible.

D. (1pt) Is this bond found in cellulose or glycogen?

6. ATP synthesis

A. (4pts) In which membanes of the following cells is ATP made: (list allmembranes that make ATP)

Bacteria

Animal cells

Plant cells

B. (2 pts) The F1F0 ATPase can work in either direction. Why might bacteria want to run the ATPase backwards?

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C. (3 pts) Fill in the blanks.) The bacterial ATP synthase contains several polypeptides; this is an example of the _____ level of protein structure. In the _____ binding state of the β subunit, ATP is formed spontaneously by joining ADP and Pi together. The subunit that interacts with the β subunit and controls its conformation is the _____ subunit. The ΔG for ATP synthesis is _____ (+ or -) and the energy is provided by _____ moving through the _____ subunit of the synthase.

7. (5 pts) Draw a peptide bond between two amino acids with R goups R1 and R2. Circle the peptide bond and indicate amino and carboxyl ends.

8. (6 pts) Complete the table below by indicating where the molecules/structures on the left would be found. An example of what you are to do is found in the first row.

	Nucleus	Extracellular Matrix	Cytoplasm	Mitochondria	Chloroplasts	Plasma Membrane
Lipids	X		X	X	X	X
DNA						
RNA						
Protein						

9. (3pts) What are the three tenents of the cell theory?

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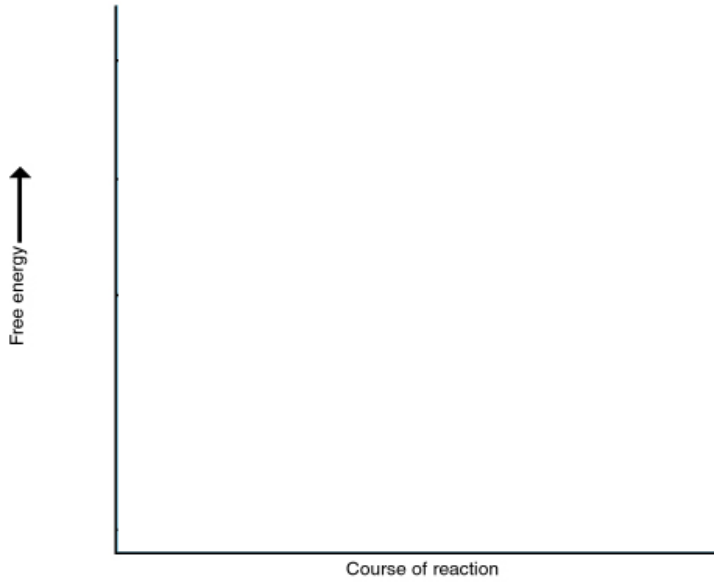
10. (3pts) It is known that viruses use DNA or RNA as their genetic material and some have replication and transcription machinery. Why are viruses still not considered cells?

11. (5pts) Given the following amino acid sequence comes from a polypeptide that spans the membrane one time and is not a transport protein. Circle the portion of the oligopeptide sequence that is probably embedded in the membrane bilayer.

N - Alanine-Tryptophan-Isoleucine-Proline-Glycine-Serine-Aspartic Acid-Histidine-Tyrosine-Asparagine-Lysine - C

Give a reason for your answer

12. (6pts) How do enzymes increase the rate of a reaction ? Illustrate your answer below by drawing a free energy diagram showing a) an enzyme catalyzed and b) an un-catalyzed reaction. Draw a reaction course in which DG is positive and label all pertinent parts of the curve.



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13. You are working on a new cytoskeletal protein named DB.
    A. (3pts)You want to know where does protein DB localizes inside the cell. What light microscopic technique will you use to visualize DB? Briefly describe how this technique works.

    B. (2pts) When you use blue light to image DB you have a resolution of 200nm. You now switch and use red light (600nm) to view DB. The numerical aperature (NA) of the two objectives is identical. What is the resolution using red light? Show your work.

14. (4pts)You are studying the ability of a certain mitochondrial preparation to synthesize ATP. You notice that when you apply cyanide, the production of ATP is abolished completely. Given that cyanide blocks respiratory electron transport, how would you explain your observation?

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15. Bonding.

A. (2pts) Define a covalent bond in 1 sentence.

B. (2pts) Why are some covalent bonds polar? (What makes a covalent bond polar?)

C. (2pts) What type of weak bond can form between atoms involved in polar covalent bonds?

16. Photosynthesis

A. (2pts) In the big picture, animal cells are dependent on photosynthesis to provide

_____ and _____ that are needed by heterotrophs.

B. (4pts) The light reactions of photosynthesis occur across the thylakoid membrane and are vectorial, that is the side of the membrane where a reaction occurs is important. State whether the following processes or reactions occur in the lumen of the thylakoid or in the stroma.

O_2 synthesis

NADPH synthesis

Accumulation of H+ in solution

ATP synthesis

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17. You work in a lab studying the characteristics of a mutant unicellular algae that has lost the ability to transport glucose. You have identified the mutant polypeptide and it has several domains that fold into α-helices. The folded polypeptide also contains two distinct binding sites. While examining this mutant further you discover that the mutant protein binds glucose well, but it does not transport glucose inward.

A. (2pts) What type of membrane transport could the non-mutant protein facilitate? Explain your reasoning.

B. (3pts) Propose a possible explanation for what is wrong with the mutant protein.

18. Evolution

A. (1pt) The first organelle thought to have evolved in eukaryotes was the _____(fill in the blank), and the first fossils of this organelle date back about 1.7 billion years.

B. (4pts) Briefly describe how this organelle is thought to have evolved.

19. (3pts) Fill in the blanks.

A. _____ is a molecule that donates 2 high energy electrons to the respiratory electron transport chain. To reduce the oxidized form of this molecule requires _____ (how many) H^+ and _____ (how many) electrons.

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20. (4pts) Recent molecular data indicate that all of life can be classified into three major domains. What are they? Circle the domain from which mitochondria arose.