**Chemistry 4055 (Spring 2013)**

**Biochemistry I- Introduction to the Chemistry of the Animal Cell**

**HW Set 4 Assignment**

**PLEASE WRITE YOUR ANSWERS ON A SEPARATE SHEET OF PAPER OR USE THIS TEMPLATE AND ADD SPACES.**

**Chapter 10**

1. What is the oxidation state for the carbon highlighted in red in the following molecules?



2. Draw the following fatty acids in a physiologically relevant manner. Then rank them in order of lowest to highest melting points and water solubility.

a. 16:0

b. 16:1 (Δ9)

c. 16:2 (Δ9,12)

3. In what way are birds waterproof?

4. Draw the structure of the triacylglycerol where myristic acid is at the C1 position, palmitoleic acid is at the C2 position, and stearic acid is at the C3 position. Is the triacylglycerol more or less soluble than its structural components?

5. How are galactolipids different from glycerophospholipids? Why do plants favor galactolipids?

6. The plasma membrane is largely composed of phospholipids, namely phosphatidylcholine. The polar groups on these amphiphatic molecules are oriented to the extracellular region on the outer leaflet and the cytosolic region on the inner leaflet. What accounts for the charges of these groups and how does the charges of these groups affect the type of biomolecules that interact with them?

7. Phospholipids are degraded in lysozymes via very specific hydrolytic enzyme called lipases. Given the following information:



Draw the products of the following reaction:

Phosphatidylcholine + phospholipase C

8. In addition to playing roles of storage and structure, what are three other roles that lipids play and list a representative lipid?

9. Why is extraction and purification of lipids different from that of non-membrane proteins?

**Chapter 11**

1. Describe the different ways in which biological membranes are asymmetric.

2.Use the simplified diagram of the plasma membrane to answer the following questions by choosing component A, B, C, D, or E.



a. This component could be a glycoprotein.

b. This component can probably be separated from the others by simply washing the membrane with neutral salt solutions (mild conditions).

c. In order to separate this component from the others, harsh conditions, such as strong detergents, are needed.

d. This component is the only component that might bind and transport sodium ions across the membrane.

e. This component could be a ceramide or a ganglioside.

f. This component might be able to flip-flop transversely with the assistance of a flippase.

3. A membrane consisting only of phospholipids undergoes a sharp transition from the crystalline form to the fluid form as it is heated. However, a membrane containing 80% phospholipid and 20% cholesterol undergoes a more gradual change from crystalline to fluid form when heated over the same temperature range. Explain why.

4. Hydropathy plots can be used to predict whether a protein based on its AA sequence will have transmembrane domains. In class I showed you an example of how to construct a hydropathy plot for the transferrin receptor 1. Now I want you to do the same thing for the transferrin receptor 2. First go to the website http://www.uniprot.org. In query type in human transferrin receptor 2 (TfR2) and hit search. Click on the corresponding entry. Then spend a moment examining the information that is listed for the protein. List the part of the sequence that corresponds to a transmembrane domain? What type of integral protein is the human TfR2?

Scroll down to the sequence itself (the isoform alpha is fine). Copy the sequence. Now go to the website http://www.vivo.colostate.edu/molkit/hydropathy/. Paste your sequence in the space allotted. (You may have to do a JAVA update/download.) Next to the plot icon, click on the Kyte-Doolittle scale and enter 20 for the Window size. Now click on plot. Paste a print-screen image of your data output on your HW page. Does the plot predict a transmembrane? Please label on your plot where the transmembrane is present and indicate whether this is in agreement with the information provided by the uniprot website. Does the information you obtained tell you whether the protein has an alpha helix or beta barrel transmembrane domain? Explain.

5. Describe the typical compositions of caveolins and also how these structures can perturb membranes.

6. Nerve cell communication involves what kind of membrane fusion from the perspective of the presynaptic neuron?

7. There is a size restriction in terms of cell permeability. Under what conditions can membrane permeability be altered to enable bigger things to diffuse?

8. Distinguish between passive and active solute transport. Why does transport in general result in a ΔG’° = 0?

9. Calculate ΔGT when C1 = 10 x C2. Is this transport with or against the electrochemical gradient?

**Chapter on Introduction to Metabolism**

1. What type of transporter is GLUT1, a carrier or channel?

2. Why is dipeptidyl peptidase IV a drug target for antidiabetes research?

3. Why are amino acids, monosaccharides, and fatty acids called metabolic fuels but not nucleotides?

4. What is the difference between the way polysaccharides are broken down in digestion and in the way they are broken down when mobilized by the body?

5. Given the following reaction:



a. What is the value of the Keq for the reaction at 25°C when equilibrium concentrations of the reactants and products are as follows: [phosphoarginine] = 0.737 mM, [ADP] = 0.750 mM, [arginine] = 4.78 mM, and [ATP] = 3.87 mM?

b. What is the value of ΔG’° for this reaction? Is it spontaneous under biochemical standard conditions?

c. What is the value of ΔG when [phosphoarginine] = 5 mM, [ADP] = 4 mM, [arginine] = 0.78 mM, and [ATP] = 0.87 mM? Is the reaction spontaneous?