1. Based on the labeled structures in the diagram below, answer the following questions:

   a) List 3 classes of lipids which may be found in this structure.

   **Phospholipids, glycolipids, sterols**

   b) What is the primary force (or bonds) stabilizing the structure at (a) and why do the molecules interact in this fashion?

   *hydrophobic interactions – non-polar groups are trying to escape from water*

   c) Is the portion of the molecule at the end of arrow (f) hydrophilic or hydrophobic?

   **hydrophilic**
d) If all of the lipids in this structure had saturated hydrocarbon chains what effect would this have on the properties of the bilayer and on its phase transition point?

The bilayer would become more solid or crystalline because saturated fatty acids pack together more tightly than do unsaturated fatty acids and this would raise the phase transition point.

e) What would be the effect on the properties of the bilayer and on its phase transition point if half the normal amount of cholesterol was present in the membrane?

Sterols prevent tight packing of the fatty acid chains, much as unsaturated fatty acids do. Thus the bilayer would become more solid or crystalline when there are fewer of them present. This would raise the phase transition point of the membrane.

f) In proteins A/B and C/D/E, which regions of both will probably have large numbers of hydrophobic amino acid residues?

B and D

g) In protein C/D/E, which region will have the carbohydrate attached?

C

2. Provide evidence from at least one experiment that supports the Singer-Nicolson model of membrane structure. Explain what feature of the model this evidence supports.

Frye-Edidin expt – fluidity of membrane
Gorter and Grendel – lipid bilayer structure
And many others
3. Given the cell pictured below, complete the following questions regarding the four transport processes indicated with letters A, B, C and D.

- **a)** Which is the primary active transport process? What is its energy source?
  
  B  ATP is its energy source

- **b)** What type(s) of gradient(s) does it produce?

  **Proton gradient – pH and electrical gradients**

- **c)** Which are the secondary active transport processes? What type is each? What supplies the energy for each?

  C and D  – Both are antiport; energy from the proton gradient

- **d)** Which is (are) the facilitated diffusion process(es)? What supplies its (their) energy?

  A  Electrical difference produced by the proton gradient
4. The Km of ribulose bisphosphate carboxylase (Rubisco) is approximately 20 mM and the Km of another carboxylating enzyme called PEP carboxylase is about 4 mM. If we assume that a cell’s intracellular CO₂ concentration is less than 10 mM, which of these enzymes will be better at fixing CO₂? Explain your reasoning.

The K_m is the amount of substrate needed to produce half-maximal velocity of an enzymatic reaction. Therefore, at the cellular concentration of 10 mM, PEP carboxylase would be working much faster than Rubisco; it would be able to operate and considerably more than half-maximal while Rubisco would be operating well below half-maximal activity.

5. A scientist interested in studying the regulation of enzyme activity isolates an enzyme from a newly discovered bacterium that can synthesize cellulose from glucose subunits. When she tries to run this reaction in a test tube with just glucose and the enzyme she gets very little activity unless she adds ATP and an extract of the cell cytoplasm. What might this suggest is required to activate the enzyme? Explain your answer.

This suggests that phosphorylation of the enzyme is the method of activation since that would require both ATP as the source of the phosphate groups and the presence of the appropriate kinase from the cytoplasmic extract to add them to the enzyme.

What might be the mechanism of activation if she instead found that only the ATP was needed, but no cell cytoplasm? Explain your answer.

This could be explained by the enzyme being subject to allosteric regulation with ATP as the allosteric effector molecule that binds to the regulatory site thus activating the enzyme.