CHEM106 PS-3 Due at the beginning of class

1. The log P for chloroform ($CHCl_3$) was found to be 1.97 for a mixture of 200 mL of water and 300 mL of 1-octanol.
    a. Calculate the value of the partition coefficient P.
    b. Based upon the value of P, discuss the underlying reasons (in terms of intermolecular forces) for the solubility behavior of chloroform in 1-octanol vs. water.
    c. If the water phase had a chloroform concentration of 0.125 mM, calculate the expected concentration of chloroform in the 1-octanol phase.
    d. Describe how the two chloroform concentrations would change (increase, decrease, or no change) if 100 mL of water were added to the mixture.
    e. For the addition of this 100 mL of water to the mixture, predict whether and how the total mass of chloroform present in the octanol phase would change.
    f. Draw a diagram of a container holding this mixture and clearly label the concentration of each of the phases.
    g. Use thermodynamics to explain and to predict how the concentration of chloroform in water would change with an increase in temperature (assume constant volumes of liquids).

2. Explain how each of the following properties affects membrane fluidity; clearly explain why for each of these:
    a. Temperature
    b. Increase in the chain length of phospholipid fatty acid components
    c. Increase in the degree of unsaturation of phospholipid fatty acid chains
    d. Increase in the amount of cholesterol found in the membrane

3. Draw the structure of two types of phospholipids showing all atoms, bonds and charges; clearly label the subcomponents for each of these.

4. Postulate two ways in which a microorganism might specifically adjust the lipid composition of its membranes to maintain membrane fluidity under a decrease in temperature in its local environment. Clearly and completely explain the reasoning involved.

5. Describe the asymmetric distribution of phospholipids and glycolipids in a typical plasma membrane.

6. Draw the molecular structure and rank order (in increasing order) the P values of the following substances: phenol, benzene, ethylene glycol, ethanol, and chlorobenzene. Clearly explain the rationale for your ranking using fundamental concepts of intermolecular forces.

7. Draw a clearly labeled molecular structure for an omega-3 fatty acid showing all bonds. Then summarize the health benefits of this group of fatty acids; compare these to omega-6 fatty acids.

8. In low daily doses (81 mg), aspirin is used to decrease the risk of coronary and cerebrovascular disease. If an adult takes one low dose aspirin tablet, calculate the number of molecules being consumed for each human cell in an adult. Clearly show the basis for all of your calculations, all equations, and all work. Comment on the magnitude of your answer.