CHEM106 Test 2 Exam
You must show all equations and all work to receive any credit

1. Cystic Fibrosis is thought to result from genetic mutations in a cAMP regulated chloride ion channel; a good deal of modern CF research centers on therapeutics to modulate membrane conductances in these channels.

    a. Using intracellular / extracellular **chloride** concentrations of 60 mM and 560 mM respectively, calculate the change in Gibbs Free Energy required to move chloride ions across the concentration gradient from intracellular to extracellular regions. Do not consider any membrane potential that may be present.

    b. For a membrane potential of -65 mV, calculate the change in Gibbs Free Energy that would be required to move chloride ions from intracellular to extracellular regions. Do not consider any concentration gradient in your calculations.

    c. Using both the concentration gradient and membrane potential from parts a and b above, determine what spontaneously occurs when a chloride ion channel is opened. Support your answers with calculations. Draw a diagram that clearly shows the chloride ion concentrations and the membrane voltage across the inlet and outlet of the chloride ion channel and that clearly shows the spontaneous direction of ion flow.

    d. Clearly explain the scientific basis for each of the opposing processes involving ion flow.

2. Identify the three major classes of opioid receptors and clearly explain the mechanism of action for each of these. Your explanation should clearly show how the described mechanism causes the specific biological effect associated with the therapeutic administration of opioids.

3. Identify the name for the class of medicines used to treat schizophrenia. Describe the mechanism of action for these substances and then outline how they were originally discovered. Finally, describe the new areas of schizophrenia research and the possible drug targets for these candidate medicines.

4. Draw the structure of an acetylcholine (Ach) molecule as it is situated in the active site of acetylcholinesterase. Show the side groups and the noncovalent interactions involved in holding Ach in the active site. Identify each of the three key amino acids involved in the catalytic triad for hydrolysis. Outline the mechanism of the initial step in the hydrolysis process.

5. Bupivacaine has a pKa of 8.1. Calculate the percentage of bupivacaine molecules that are not ionized at a physiological pH of 7.4.

6. Describe the detailed mechanism of action for bupivacaine; also include clearly labeled diagrams in addition to your explanation.

7. Draw the complete Lewis structure for an amphetamine molecule at physiological pH of 7.4 [except for aromatic rings, show all atoms, bonds, lone pairs, and full charges (not partial charges)].

8. Provide a clearly outlined and detailed molecular mechanism of action for amphetamines. Discuss the both the historical and present-day (legal) use of amphetamines.