CHEM106 Test 2 *Name on back only please..*

Please show all work and all equations to receive any credit

1. Adrenergic receptors are G-protein coupled receptors (GPCRs); answer these questions on GPCRs:

    a. Draw the prevalent molecular structure (at physiological pH) for the neurotransmitter ligand that activates adrenergic GPCR receptors; include the name of the molecule with your structure. Show all atoms (except for aromatic rings) and full charges.

    b. Draw a diagram and describe the overall structure of GPCRs.

    c. Outline a very detailed sequence of steps clearly explaining the entire mechanism of action of GPCRs.

    d. Explain, in detail, the action of an inverse agonist on GPCRs; be very specific.

2. Much of what we know about how nerve cells work comes from studying neurons in squids. Squids have intracellular / extracellular potassium concentrations of 400 mM and 20 mM respectively. Squids have intracellular / extracellular sodium concentrations of 50 mM and 440 mM respectively. Squids have intracellular / extracellular chloride concentrations of 60 mM and 560 mM respectively. You are developing a science fiction novel that describes how squid nerves might work on planet Squeron where squid neuron membranes are actually most permeable to sodium ions. Answer the following questions:

    a. Assuming ion concentration gradients are similar for Earth and Squeron, calculate the Nernst potentials for sodium and potassium on Squeron if squid body temperatures there are 325 K.

    b. Estimate what the membrane resting potential would be on planet Squeron; fully explain your reasoning. Draw a picture that clearly shows the polarity of the resting potential.

    c. For ligands that open up chloride ion channels, predict and explain what neural effects (excitatory or inhibitory) these ligands would have in squids on planet Squeron. Draw a diagram showing membrane potential changes and fully explain why.

    d. For ligands that open up sodium ion channels, predict and explain what neural effects (excitatory or inhibitory) these ligands would have in squids on planet Squeron. Draw a diagram showing membrane potential changes; fully and clearly explain why they occur.

    e. Using your estimated resting membrane potential, calculate the change in Gibbs Free Energy required to move a mole of positive ions out of the cell.

    f. Now use the concentration gradients given above to calculate the change in Gibbs Free Energy required to move a mole of sodium ions out of the cell.

3. Explain the mechanism of action for local anesthetics; be very specific and draw diagrams. Also explain why epinephrine is sometimes added to local anesthetics and clearly explain its mechanism of action.

4. Draw the reaction catalyzed by acetylcholinesterase; show the complete molecular structure of all reactants and products in their most prevalent forms respectively at physiological pH.

5. Outline the sequence of steps that occurs with the transmission of a nerve impulse across a synapse. Identify five mechanisms through which the neural transmission process can be modulated by toxic substances or by medications.

6. According to the National Institute of Mental Health 2008 statistics, an estimated 26.2 percent of Americans, one in four adults, suffer from a diagnosable mental disorder in a given year. Major Depressive Disorder is the leading cause of disability in the U.S. for ages 15-44 and affects approximately 14.8 million American adults, 6.7 percent of the U.S. population, in a given year. Outline the four classes of medications used historically to treat depression and clearly outline the specific mechanism of action for each class.