Problem Set I

1) The electrochemical potential μ of an ion of charge z in an electrostatic field ψ is defined by the equation

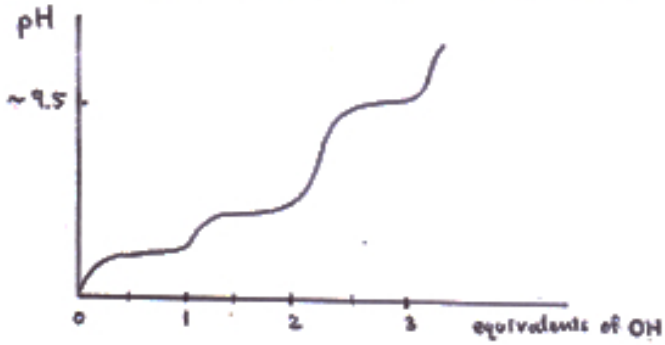
$$\mu = zF\psi + \mu^\circ + RT \ln X$$

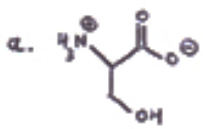
where μ° is the chemical potential of the ion in standard state and X is mole-fraction of the ion in the solution $X = \frac{\text{mol of ion}}{\text{mol of ion + mol solvent}}$ (mol·sol) $\gg$ (mol·ion) $\longrightarrow$ $\frac{\text{mol of ion}}{\text{mol of solvent}}$

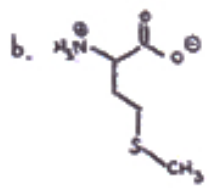
Derive an expression for the difference in electrochemical potential for protons across the membrane.

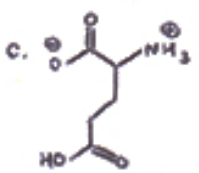
2) The formation of glucose-6-phosphate from glucose and ATP is catalyzed by hexokinase Given ΔG° (glucose-6-phosphate) = −13.9 kJ/mol and ΔG° (ATP) = −30.5 kJ/mol, calculate values for the standard state free energy change and the equilibrium constant of the reaction at 298 K.

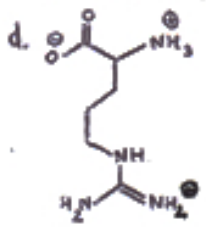
3) Which amino acid does this pH-titration curve belong to



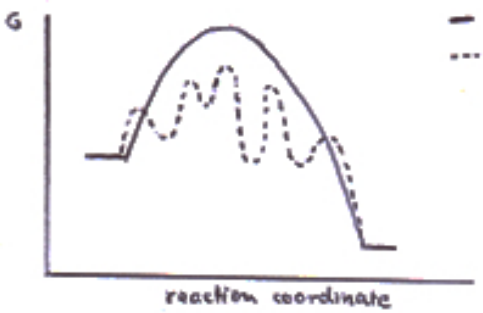
a. 

b. 

c. 

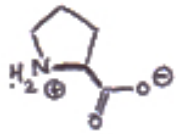
d. 

4) According to the given energy diagram, indicate the limiting step for each reaction.



— without enzyme
--- with enzyme

5) Provide explanations why Proline is a "helix-breaker" as it is rarely found within α-helical segments.



Given that in α-helix, polypeptide backbone is folded such that −C=O group of each residue is H-bonded to ~N−H group of the 4th-residue of the chain (i.e. 1st (−C=O) bonds to 5th (−N−H) and so on)