

- Question paper is for 90 points, to be answered in 180 minutes; as a rough guideline plan to spend 2 min per point for the length of the answer required. Total of 10 questions.
- 1. (5 points) Lactic acid can lose one proton to produce lactate ion. Calculate the pK_a of lactic acid given that when the concentration of lactic acid is 0.010 M and the concentration of lactate is 0.087 M, the pH is 4.8
- 2. (15 points) Make a table with the following columns for all naturally occurring amino acids: name, chemical structure, expected pK_a , structures corresponding to each 'protonation state'
- 3. (10 points) Draw the structure of each nucleotide base pair occurring in DNA; indicate clearly where 3' and 5' locations. Also draw the structures of the Hoogsteen base pairing. *p bonding*
- 4. (10 points) What is Grotthuss mechanism? Take an example of a protein and illustrate it (proton wire) in the function of the protein.
- 5. (5 points) What is mutarotation. Demonstrate with example.
- 6. (10 points) pH is one of the factors that control functioning of proteins; write a note on how it controls the respiratory process.
- 7. (10 points) The transition state theory has specific predictions on the various factors that control the specificity and selectivity of enzymatic action. Elaborate.
- 8. (8 points) What is glycosidic bond? Draw at least 3 stable conformations, with clear indications of reasons of stability.
- 9. (7 points, total) There are almost 500 naturally occurring variants of hemoglobin. Most are the result of a single amino acid substitution in a globin polypeptide chain. Some variants produce clinical illness, though not all variants have deleterious effects. A brief sample is presented below.
 - HbS (sickle-cell Hb): substitutes a Val for a Glu on the surface *↓*
 - Hb Cowtown: eliminates an ion pair involved in T-state stabilization
 - Hb Memphis: substitutes one uncharged polar residue for another of similar size on the surface *↑*
 - Hb Bibba: substitutes a Pro for a Leu involved in an α helix
 - Hb Milwaukee: substitutes a Glu for a Val *↓*
 - Hb Providence: substitutes an Asn for a Lys that normally projects into the central cavity of the tetramer
 - Hb Philly: substitutes a Phe for a Tyr, disrupting hydrogen bonding at the $\alpha_1\beta_1$ interface
- 10. (10 note) Write a note on the primary, secondary and tertiary structure of RNA.