

Biomolecular structures: Quiz. 03-April-2023. 12noon (45 min)

- Question paper is for 45 points; as a rough guideline plan to spend 1 min per point for the length of the answer required
- This quiz is also the assignment. Submit by 10-April-2023 11:30am (handwritten only)

1. (8 points) Make a table with typical length and volume of (a) single eukaryote cell, (b) mitochondria of that single cell and (c) a protein molecule in that cell and finally (d) a virus (say, coronavirus) that infects such cell; add an additional column to find the ratio of volumes
2. (6 points) Draw chemical structures to indicate the hydrogen bonding between (a) sidechains of proteins (specify the amino acids) and (b) backbone of proteins and (c) RNA/DNA
3. (4 points) It has long been recognised that any injections (involving of large volumes) should be isotonic so as to not disturb various biomolecular structures. Write a note on this, clearly mentioning why and the affect of non-isotonic solutions.
4. (8 points) pH is known to have important consequence to biomolecular structures; write a note on general. Additional special affect of pH on efficiency of oxygenation of hemoglobin was presented; discuss.
5. (6 points) Write a note on the levels of structure in proteins; list various interactions and where they are present stabilizing the protein structures.
6. (4 points) Write a short note on protein folding and denaturation.
7. (9 points, total) (TAKEN FROM LEHNINGER) 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

Write a short note on the structure of hemoglobin tetramer (3 points). Then, explain your choices for each of the following (2 points each):

- (a) The Hb variant least likely to cause pathological symptoms
- (b) The variant(s) most likely to show pI values different from that of HbA when run on an isoelectric focusing gel
- (c) The variant(s) most likely to show a decrease in BPG binding and an increase in the overall affinity of the hemoglobin for oxygen.