

Protein Structure and Thermodynamics

(1.)

a.) Are peptide bonds generally trans-isomerized or cis-isomerized? Why?

b.) Are there any amino acids which are an exception to this rule?

(2.) Protein folding is heavily dependent upon the amino acid interactions both within the protein itself and the protein's environment.

a.) Using your knowledge of the types of interactions discussed in class, rank the importance of different types of interactions in determining the tertiary and quaternary structure of a protein.

b.) Why is the weakest interaction between molecules actually the strongest determinant of tertiary and quaternary structure in proteins?

c.) Suppose you had a small protein with the sequence, N' - MLIIFGA AVPAALFGPIALILFA - C'. How would you expect this protein to behave in an environment like human blood?

(3.) You isolate a small transmembrane protein which associates with the phospholipid bilayer of animal cells. This protein is anchored to the membrane through a polypeptide sequence N' - RSTYKRVIH - C'. Would this anchor sequence most likely be present *within* the phospholipid bilayer or on the *outer-facing* surfaces of the membrane? Explain how you arrived at your conclusion.

(4.) Briefly explain the entropic contribution to the hydrophobic effect. Illustrating your answer may help with answering this question.

(5.) What is the difference between ΔG and ΔG° ? In differentiating between the two, also describe their relationship in terms of Q and K_{eq} .

(6.) A 1M HCl solution is dissolved in water at 25°C and mixed. The enthalpy change of the water-HCl system is $\Delta H = -74.84 \text{ kJ/mol}$.

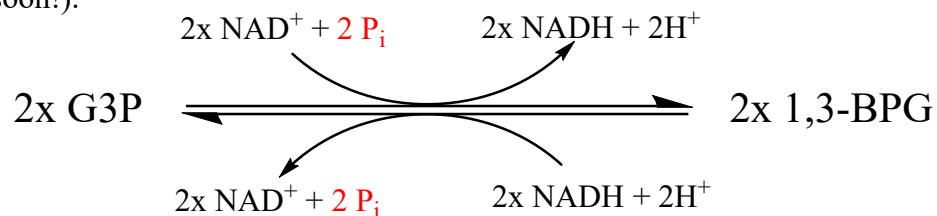
a.) Is this process endothermic or exothermic?

b.) Overall, would there be an increase or a decrease in the entropy of the system?

c.) What does this say about the spontaneity of HCl dissolution in water with mixing? Explain mathematically.

(7.) Patients suffering refeeding syndrome, a metabolic disturbance caused by the sudden reinstitution of nutrients after a long period of starvation, may experience hypophosphatemia (low concentration of phosphate compounds in blood), a potentially deadly complication that interrupts hundreds of metabolic pathways dependent on normal phosphate concentrations.

a.) One key phosphate-dependent step in metabolism is the sixth step of glycolysis (you will learn more about this process very soon!):



Under standard physiological conditions, $\Delta G^\circ = +6.3 \text{ kJ/mol}$, and ΔG is between -2 kJ/mol and $+2 \text{ kJ/mol}$. How would a decrease in $[\text{P}_i]$ (phosphate concentration) affect the spontaneity of this reaction, if at all? Explain mathematically, using the relationship between ΔG° and ΔG .

